for . . .

engineers and contractors controlling the design, specification, installation and maintenance of heating, ventilating and air conditioning.

HEATING AND VENTILATING

The Air Conditioning Monthly

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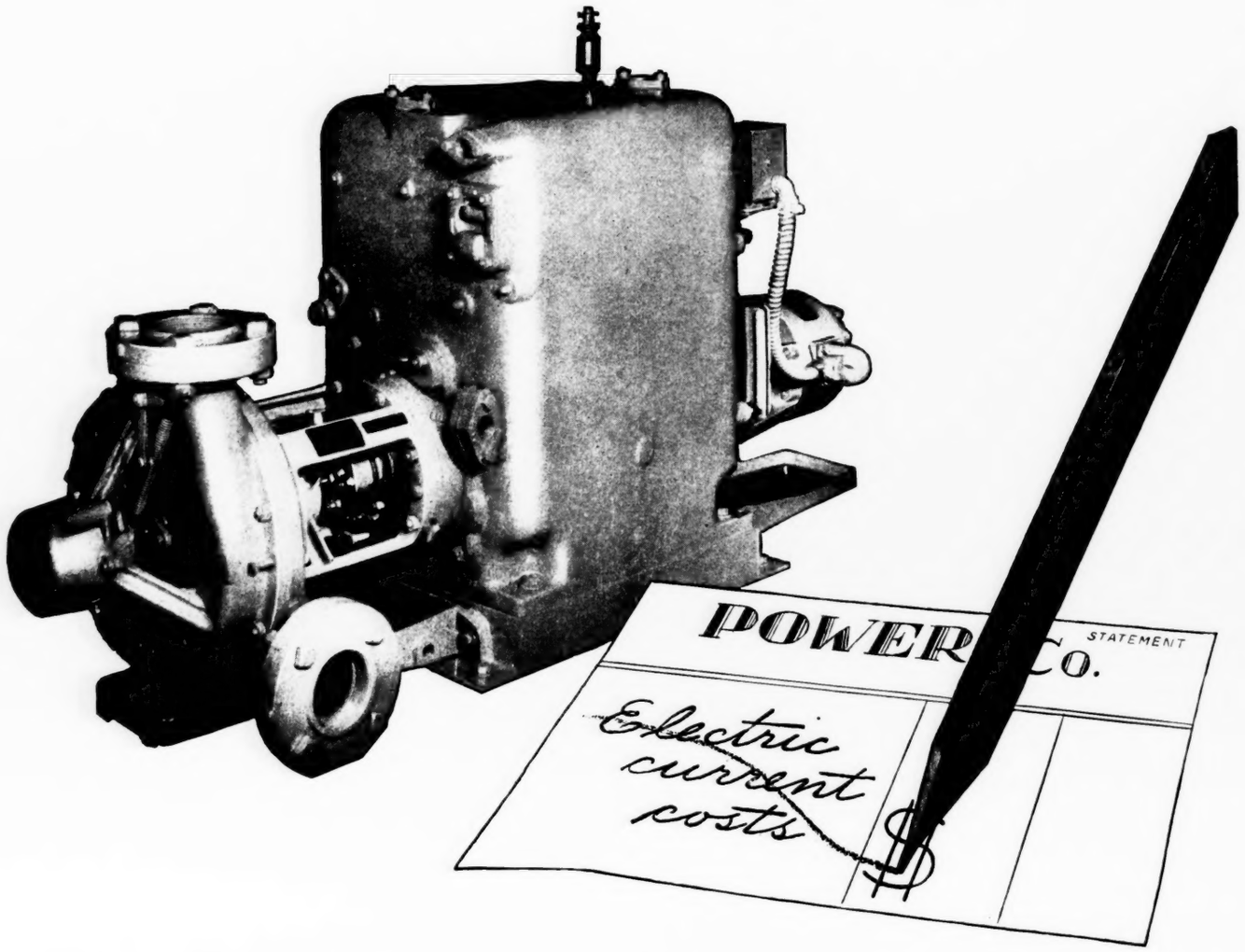
A NASH VAPOR TURBINE HEATING PUMP WILL ELIMINATE THIS EXPENSE ITEM.



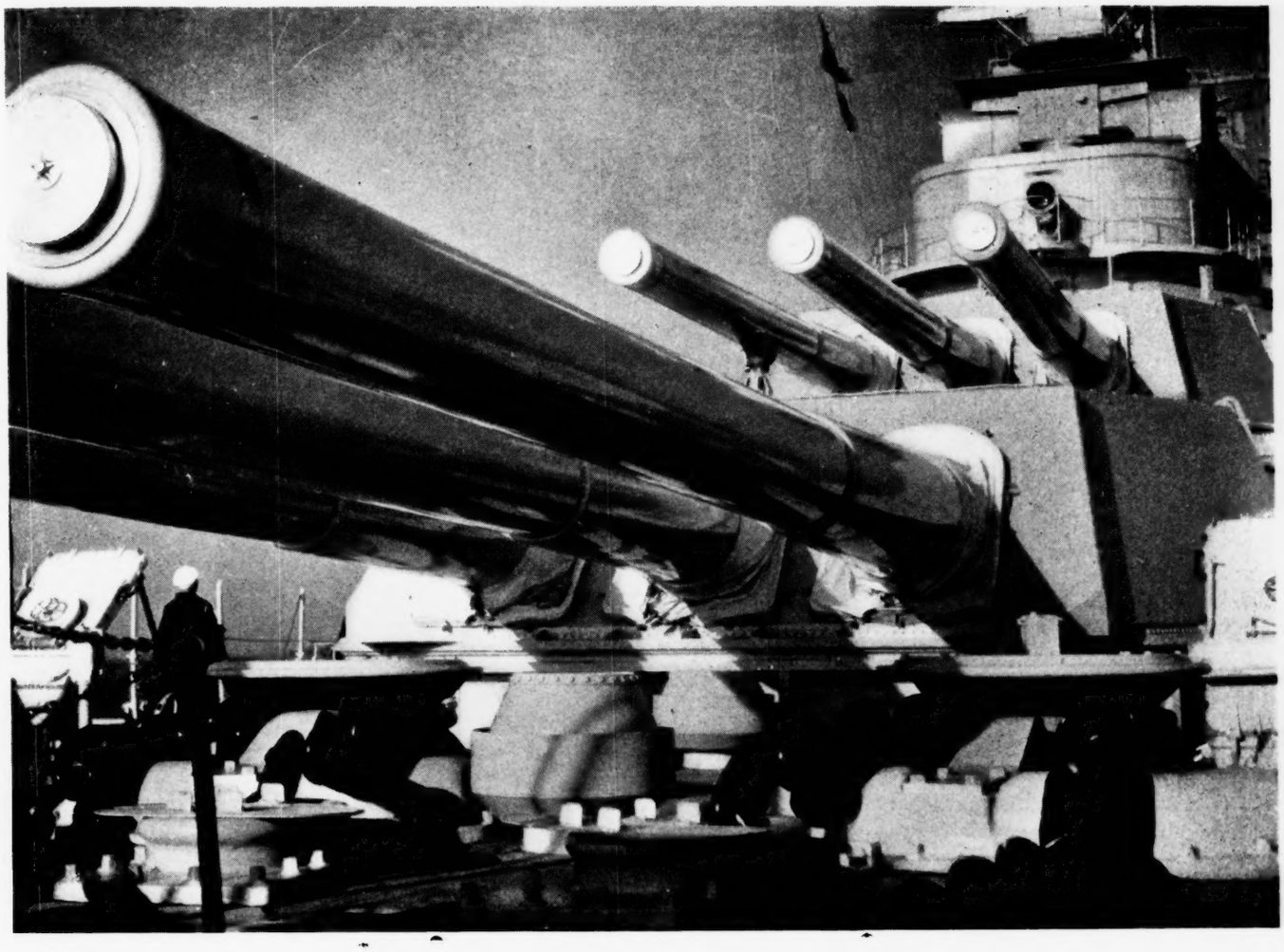
The Jennings Vapor Turbine Return Line Vacuum Heating Pump requires no electric current, eliminating the one biggest expense item in the operation of an ordinary return line pump. This is because the motive power is a special turbine operating on steam direct from the heating system. Steam used to drive the turbine is returned to the system for heating, with little heat loss.

The really important saving promoted by the Jennings Vapor Turbine is in the system itself, however, for this is the only heating pump that can operate continuously with economy. Continuous operation means uniform circulation, and uniform circulation means a big saving in steam.

This pump has but one moving part, no internal wearing parts, and no internal lubrication. It is compact and quiet, and will give long and satisfactory service at the lowest maintenance cost. Bulletin No. 246 tells all about it. It is free on request.

THE NASH ENGINEERING COMPANY

SOUTH NORWALK, CONNECTICUT, U. S. A.



Approximately $100,000 worth of ventilating fans al ne—other equipment in proportion—are required in constructing a modern battleship or aircraft carrier.

How to Get Heating Business in Navy Ships

WITH another $1,200,000,000 appropriation for auxiliary fighting ships and construction facilities being rushed through Congress to supplement the $4,600,000,000 two-ocean Navy authorized last July, heating and ventilating equipment manufacturers and engineers will find in the defense-afloat program an assured market rivaling that of on-shore requirements for defense housing and plant expansion.

In some respects the Naval program may be of even greater interest to manufacturers than the land projects, many of which are of a temporary nature, while fighting vessels require equipment built to serve for many years.

While shore construction plants and defense housing comes under the direction of the Bureau of Yards and Docks, all naval vessels are designed, constructed, and maintained, under the direction of the Bureau of Ships, which is headed by Rear Admiral S. M. Robinson. The Bureau prepares both preliminary and final plans for all new naval vessels and maintains a large group of inspectors, both naval and civilian, for the inspection of ships, machinery, and engineering materials entering into the construction of new vessels.

Ships Under Construction

The ships under construction form an impressive list. They include 17 battleships, 12 aircraft carriers, 54 cruisers, 205 destroyers, 80 submarines, and a large number of torpedo boats and many other auxiliary craft such as mine sweepers, net layers, repair ships, submarine tenders, submarine rescue vessels, seaplane tenders, mine layers and aircraft rescue boats.

How Equipment is Bought

Purchase of heating and ventilating equipment for use in naval vessels is handled in two ways. Equipment needed in vessels building in private shipyards is usually purchased directly by the contracting builder. Equipment for use in vessels being built in United States Navy Yards is generally purchased through open bidding on material schedules issued by the Navy De-

partment's Bureau of Supplies and Accounts. Such schedules are prepared from requisitions originating in Navy Yards or in the Bureau of Ships, Washington, D. C.

The only occasions on which negotiated buying is practiced is when a duplicate order is needed, for example, when it is decided to buy or build another ship of a type for which equipment has already been placed under contract. In such instances it is simpler to negotiate a repeat order.

Equipment Used

Heating of steam-driven vessels is accomplished by the use of high pressure steam, reduced to 35 or 50 pounds per square inch through lightweight fin tube convector type radiators.

Diesel-driven vessels are usually heated by steam produced by small boilers similar to those used on diesel-driven trains or by domestic type hot water steel boilers. Submarines are, of necessity, heated by electricity.

Fan-driven unit heaters of the steam fin tube type are frequently used on surface vessels to heat diesel engine rooms and other heatless machinery spaces.

Builders of Naval Vessels

As mentioned previously, heating and ventilating equipment is purchased in one or two ways. Equipment for vessels being built by private builders is purchased directly by the private builders while equipment purchased for vessels being constructed in the Navy Yards is obtained by open bidding on schedules issued by the Navy Department of the Bureau of Supplies.

To help manufacturers contact builders of naval vessels, there is published on pages 13 and 14 a complete list of all the vessels of the United States Navy which are under construction as of January 17, 1941. This list gives the names of builders, location, and type of vessels under construction. It will be noted that the list includes the names of some vessels which obviously require no heating equipment but it was felt that in order to avoid confusion it would be better to publish the complete list rather than to include only those vessels which use heating and ventilating equipment.

Status of Construction

Of the seventeen battleships listed on the following two pages, two have been launched. These are the North Carolina and the Washington, and they were constructed at the New York Navy Yard and Philadelphia Navy Yard, respectively. Seven others have had their keels laid. These seven and the contractors are as follows: The Indiana — The Newport News Shipbuilding and Drydock Company; the Massachusetts — the Quincy plant of the Bethlehem Steel Company; the Alabama—Norfolk Navy Yard; the Iowa—New York Navy Yard; the New Jersey—Philadelphia Navy Yard; and the Missouri—New York Navy Yard.

Only one aircraft carrier has been launched to date. This is the Hornet which is being built by the Newport News Shipbuilding and Drydock Company. The other eleven aircraft carriers have not had their keels laid as yet.

Fifty-four cruisers are under contract and of these six have had their keels laid. The names of the cruisers and their contractors are as follows: The Atlanta and Juneau—Federal Shipbuilding and Drydock Company; the San Diego and San Juan—Bethlehem Steel Company; the Cleveland, Columbia, Montpelier and the Denver—New York Shipbuilding Corporation.

There are eighty submarines under contract. Of these, the Tuna which was built by the Mare Island Navy Yard, was commissioned January 2, 1941. Five others have been launched. These are the Mackerel, the Gar, and the Grampus, all being built by the Electric Boat Company; the Grayling and the Grenadier—Portsmouth Navy Yard. Nine others have had their keels laid. These are the Marlin, the Drum, and Flying Fish—Portsmouth Navy Yard; the Grayback, the Gato, the Greenling and the Grouper—Electric Boat Company; and the Gudgeon and the Silversides—Mare Island Navy Yard.

Of the 205 destroyers under contract, eleven have been launched. These are the Gwin, Meredith, Wilkes and Nicholson—Boston Navy Yard; the Grayson and the Swanson—Charleston Navy Yard; the Monssen—Puget Sound Navy Yard; the Ludlow—Bath Iron Works; the Edison and Ericsson—Federal Shipbuilding and Drydock Company. Keels have been laid on thirteen others. These are the Woolsey, the Emmons and the Macomb—Bath Iron Works; the Ingraham, the Corry, the Hobson—Charleston Navy Yard; the Bristol, the Ellyson, the Hambleton and the Rodman—Federal Shipbuilding and Drydock Company; the Forrest and the Fitch—Boston Navy Yard; the Laffey and the Woodworth—San Francisco plant of the Bethlehem Steel Company; and the Farenholt—Staten Island plant of the Bethlehem Steel Company.

Of the three destroyer tenders under contract, none have had keels laid.

Two mine sweepers, the Raven and the Osprey, constructed at the Norfolk Navy Yard, have been commissioned. Ten others are under contract.

Of the 61 submarine chasers under contract, keels have been laid on approximately 26 chasers of the following contractors, Defoe Boat and Motor Works, and the Electric Boat Company.

VESSELS OF U. S. NAVY UNDER CONSTRUCTION AS OF JANUARY 7, 1941

NAME OF BUILDER	LOCATION	VESSELS
Bristol Yacht Building Co.	South Bristol, Maine	2 Coastal mine sweepers
Snow Shipyards	Rockland, Maine	4 Coastal mine sweepers
Bath Iron Works Corporation	Bath, Maine	27 Destroyers
Rice Bros.	East Boothby, Maine	2—110 ft. sub-chasers
Palmer Scott & Co., Inc.	New Bedford, Mass.	12—36 ft. aircraft rescue boats 10—29 ft. aircraft rescue boats
Geo. Lawley & Sons	Neponsit, Mass.	10—165 ft. sub chasers 12—45 ft. tank lighters
Bethlehem Steel Co., Shipbuilding Div. Fore River Plant	Quincy, Mass.	1 Battleship 4 Aircraft carriers 8 Heavy cruisers 8 Light cruisers 4 Destroyers
Staten Island Plant	New York, N. Y.	12 Destroyers
San Pedro Plant	Terminal Island, Calif.	10 Destroyers
San Francisco Plant	San Francisco, Calif.	4 Cruisers 25 Destroyers
W. A. Robinson, Inc.	Ipswich, Mass.	4 Coastal mine sweepers
Herreshoff Manufacturing Co.	Bristol, R. I.	2 Coastal mine sweepers
Electric Boat Co.	Groton, Conn.	45 Submarines
Electric Boat Co., Elco Works	Bayonne, N. J.	12—70 ft. sub chasers 12—77 ft. sub chasers 12—77 ft. motor torpedo boats
Luders Marine Const. Co.	Stamford, Conn.	10 Harbor tugs (65 ft.) 9 Bomb target boats 2 Sub chasers
Freeport Point Shipyard, Inc.	Freeport, L. I.	2—45 ft. aircraft rescue boats
Greenport Basin & Construction Co.	Greenport, L. I.	4 Coastal mine sweepers
Wheeler Shipyard	Brooklyn, N. Y.	10 Bomb target boats
Sullivan Drydock & Repair Co.	Brooklyn, N. Y.	2—165 ft. submarine chasers 1 Self propelled lighter
Robert Jacob, Inc.	City Island, N. Y.	6 Harbor tugs (65 ft.)
Henry B. Nevins, Inc.	City Island, N. Y.	4 Motor driven mine sweepers
Consolidated Shipbuilding Corporation	New York, N. Y.	4 Harbor tugs (100 ft.) 5—165 ft. submarine chasers
Federal Shipbuilding & Drydock Co.	Kearny, N. J.	5 Light cruisers 37 Destroyers
John H. Mathis Co.	Camden, N. J.	4 Boom (net) tenders
Mathis Yacht Building Co.	Camden, N. J.	2 Sub chasers (110 ft.)
New York Shipbuilding Corp.	Camden, N. J.	1 Battleship 6 Cruisers 13 Light cruisers 2 Seaplane tenders 1 Repair ship
Cramp Shipbuilding Corp.	Camden, N. J.	6 Light cruisers
Sun Shipbuilding & Dry Dock Co.	Chester, Pa.	3 Destroyer tenders 3 Seaplane tenders
Vinyard Shipbuilding Co.	Milford, Del.	12—50 ft. motor launches
American Car & Foundry Co.	Wilmington, Del.	38—45 ft. tank lighters
Dravo Corp., Neville Island	Pittsburgh, Pa.	6—165 ft. submarine chasers 16 Open lighters (500 ton)
Dravo Corp.	Stockton, Calif.	4 Gate vessels
Moore Drydock	Oakland, Calif.	3 Gate vessels
Dravo Corp.	Wilmington, Del.	11 Gate vessels
E. C. Rice & Sons	Reedville, Va.	12—26 ft. motor whaleboats
Marietta Manufacturing Co.	Point Pleasant, W. Va.	4 Boom (net) tenders
Newport News Shipbuilding & Drydock Co.	Newport News, Va.	1 Battleship 8 Aircraft carriers 4 Light carriers
Donald Roebling	Clearwater, Fla.	200 Amphibian tractors
Miami Shipbuilding Corp.	Miami, Fla.	2—54 ft. motor torpedo boats
Gibbs Gas Engine Co. of Florida	Jacksonville, Fla.	4 Coastal mine sweepers 16—30 ft. bureau type landing boats
Marine Engine Works & Shipbuilding Corp.	Tarpon Springs, Fla.	12—30 ft. motor launches
Gulf Shipbuilding Corp.	Chickasaw, Ala.	4 Destroyers
Ingalls Shipbuilding Corp.	Birmingham, Ala.	4 Net laying vessels
Higgins Industries, Inc.	New Orleans, La.	2—80 ft. motor torpedo boats 67—30 ft. Eureka landing boats 335—36 ft. Eureka landing boats
Consolidated Steel Corp., Ltd.	Orange, Texas	12 Destroyers

VESSELS OF U. S. NAVY UNDER CONSTRUCTION AS OF JANUARY 7, 1941 *(Continued)*

NAME OF BUILDER	LOCATION	VESSELS
Livingston Shipbuilding Co.	Orange, Texas	24—30 ft. bureau type landing boats
Seabrook Yacht Corporation	Houston, Texas	8—36 ft. aircraft rescue boats
Westergard Boat Works, Inc.	Rockport, Texas	2—110 ft. subchasers
Harbor Boat Co.	Terminal Island, Calif.	15 Bomb target boats
Los Angeles Shipbuilding & Dry Dock Corp.	San Pedro, Calif.	3 Repair ships
Consolidated Steel Corp.	Maywood, Calif.	32 Tank lighters
General Engineering & Drydock Co.	Alameda, Calif.	4 Boom (net) tenders 4 Mine sweepers
Pacific Drydock & Repair Co.	Oakland, Calif.	1 Covered lighter (500 ton) 1 Covered lighter (250 ton)
Moore Dry Dock Co.	Oakland, Calif.	2 Submarine tenders 5 Submarine rescue vessels
Western Pipe & Steel Co.	San Francisco, Calif.	11 Covered lighters (500 ton)
Basalt Rock Co., Inc.	Napa, Calif.	8 Open lighters (500 ton) 2 Fuel-oil barges
Commercial Iron Works	Portland, Ore.	4 Boom (net) tenders
Willamette Iron & Steel Corp.	Portland, Ore.	2 Mine layers
Birchfield Boiler Co.	Tacoma, Wash.	1 Covered lighter (500 ton)
J. K. Welding Co., Inc.	Seattle, Wash.	2 Car floats
J. K. Welding Co., Inc.	Brooklyn, N. Y.	7 Covered lighters (500 ton) 1 Covered lighter (250 ton)
Associated Shipbuilders, Inc.	Seattle, Wash.	4 Seaplane tenders (small) 2 Covered lighters (500 ton)
Pacific Car & Foundry Co.	Seattle, Wash.	1 Covered lighter (500 ton)
Puget Sound Bridge & Dredge Co.	Seattle, Wash.	1 Open lighter (500 ton)
Seattle-Tacoma Shipbuilding Corp.	Seattle, Wash.	25 Destroyers
Lake Washington Shipyards	Houghton, Wash.	6 Seaplane tenders 1 Covered lighter (500 ton) 1 Covered lighter (300 ton)
Goodyear Tire & Rubber Co.	Akron, Ohio	564 Rubber boats
American Shipbuilding Co.	Cleveland, Ohio	12 Boom (net) tenders
Fisher Boat Works	Detroit, Mich.	3—110 ft. submarine chasers
Robinson Marine Construction Co.	Benton Harbor, Mich.	2 Bomb target boats
Defoe Boat & Motor Works	Bay City, Mich.	4 Mine sweepers 3 Harbor tugs (large) 13—165 ft. sub chasers
Manitowoc Shipbuilding Co.	Manitowoc, Wis.	10 Submarines
Peterson Boat Works	Sturgeon Bay, Wis.	12—40 ft. motor launches
Leathem Smith Coal & Shipbuilding Co.	Sturgeon Bay, Wis.	1—165 ft. submarine chaser
Lake Superior Shipbuilding Co.	Superior, Wis.	2 Fuel oil barges
Navy Yard	Portsmouth, N. H.	17 Submarines
Navy Yard	Boston, Mass.	21 Destroyers 2 Seaplane tenders 3 Seaplane derricks
Navy Yard	New York, N. Y.	5 Battleships 1 Covered lighter
Navy Yard	Philadelphia, Pa.	6 Battleships 2 Destroyers 1 Mine layer 2—80 ft. motor torpedo boats
Norfolk Navy Yard	Portsmouth, Va.	3 Battleships 2 Destroyers 3 Mine sweepers 1 Range tender 1 Covered lighter (500 ton) 1 Floating workshop 1 Water barge 1—54 ft. aircraft rescue boat
Navy Yard	Charleston, S. C.	15 Destroyers 4 Seaplane derricks 1 Harbor tug (small)
Navy Yard	Mare Island, Calif.	8 Submarines 3 Submarine tenders
Puget Sound Navy Yard	Bremerton, Wash.	9 Destroyers 4 Seaplane tenders (small) 5 Seaplane derricks
Navy Yard	Cavite, P. I.	3 Open lighters (250 ton) 1 Water barge
Navy Yard	Guam, Midway Islands	3 Open lighters (100 ton)
Navy Yard	U. S. Coast Guard	6—35 ft. motor whaleboats 8—26 ft. motor whaleboats

1941 Heating Business in Defense Housing

is to come primarily from projects to house civilian defense workers and families of enlisted personnel, HEATING & VENTILATING survey shows.

AS of the second month of 1941, where does the manufacturer of heating equipment and the installing contractor stand in the National Defense program of troop and civilian housing?

Has the peak demand for his equipment and services already passed or are they yet to come?

In troop housing, all scheduled to be ready for occupancy by March 1, purchasing arrangements have undoubtedly reached their peak, while the bulk of installation is yet to be completed, according to late reports from the Construction Division of the Office of the Quartermaster General, U. S. Army, Washington, D. C.

In the field of defense housing for civilian workers and the families of enlisted personnel, the answer lies in the following report of C. F. Palmer, Defense Housing Coordinator:

STATUS OF PUBLIC DEFENSE HOUSING JANUARY 21, 1941

	Funds Allocated	Contracts Awarded	Completed
Number of states and territories....	40	36	5
Number of localities.....	95	72	9
Number of projects.....	185	107	9
Number of family dwelling units...	54,283	32,166	1,035
Civilian industrial workers	21,992	12,142	...
Other civilians, employes of Army-Navy	8,696	4,901	582
Married enlisted personnel	23,595	15,123	453

PRIVATE CONSTRUCTION UNDER FHA

	Week Ended Jan. 18	Previous Week
New homes started	2,597	2,555
Mortgages selected for appraisal.....	4,261	3,876

With 54,283 publicly financed defense housing units authorized, 32,166 contracted for and 1,035 completed, it is apparent that the big push in this field is yet to come and that the heating and ventilating industry has not yet begun to feel the pressure of either equipment demand or installation service requirements. Of the 32,166 units for which contracts have been let, it should be remembered that the ink is hardly dry on many of these contracts and that in such instances sufficient time has not elapsed for general contractors to file any great bulk of their requests for quotations.

As summarized by Coordinator Palmer, whose office has been transferred to the Office of Emergency Management, the status of the defense housing projects on January 21 was as follows:

Navy

The Navy had 15,915 dwelling units under construction in vital defense areas for the families of enlisted personnel and civilian workers in Government plants.

Army

The Army is preparing one project in the Canal Zone comprising 825 dwelling units for families of enlisted personnel. The other Army construction is being made by the PBA and includes 27 projects under construction and 13 additional awarded.

Federal Works Agency

The Federal Works Agency reported contract awards made recently through Public Buildings Administration for 535 dwelling units to be built at a cost of $1,698,500. The projects will be located at Fort Sill, Okla., Jackson, Miss., Fort Meade, South Dakota, Riverside, Calif., and West Palm Beach, Fla. Also another group of projects totaling 1,100 units to be located at Tucson, Ariz.; San Rafael, Cal.; Boise, Idaho; Ayer, Mass.; and San Antonio, Texas.

Award of these contracts brings the total of Public Building Administration defense housing projects in 36 locations to 9,547 units.

Defense Homes Corporation

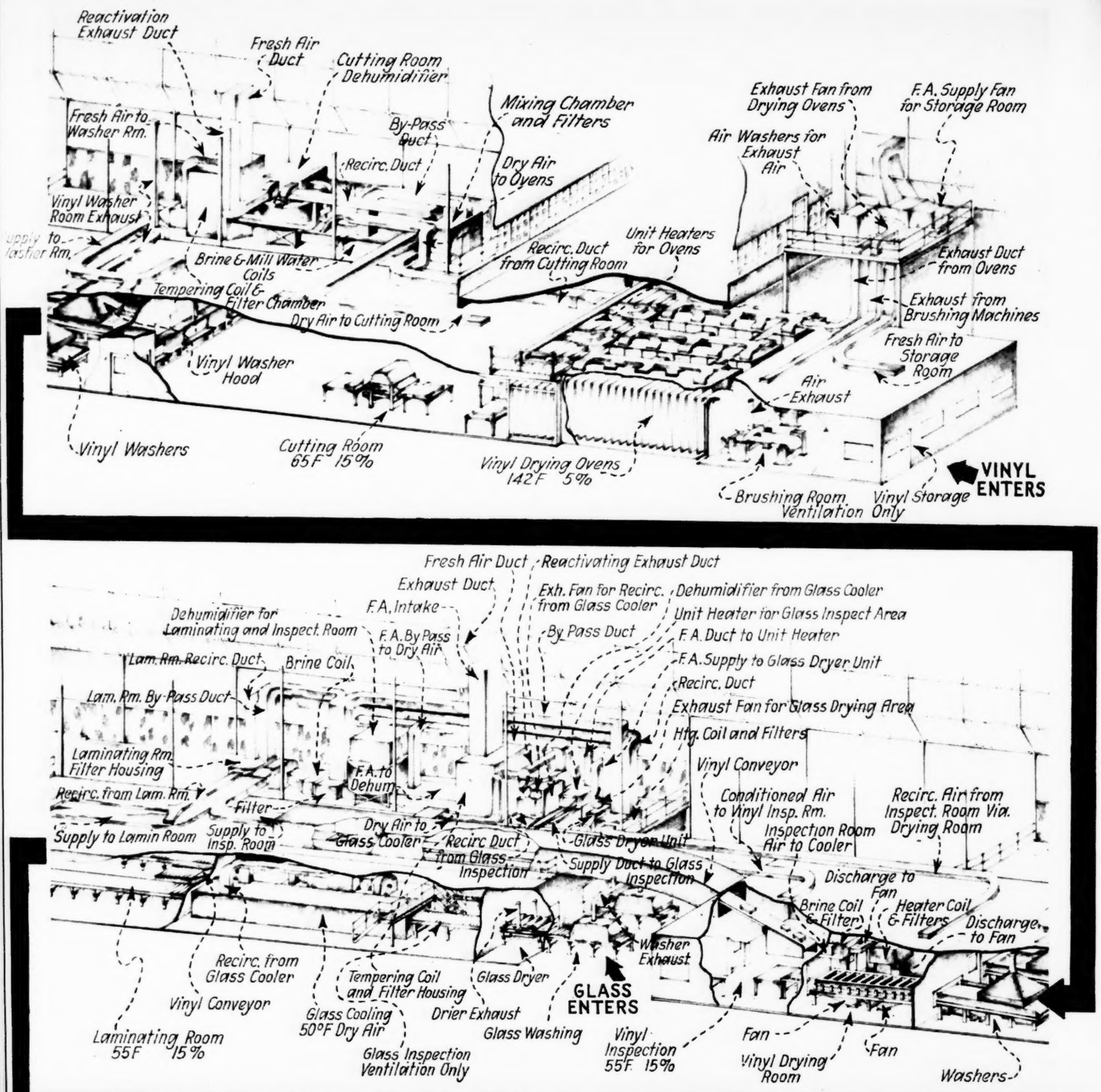
The Defense Homes Corporation has approved the construction of 1944 dwelling units, locations of which will be announced later. (Homes in this group should be of particular interest to the heating and ventilating industry, for DHC authorization usually involves the construction of homes intended for occupancy by those in higher income brackets.)

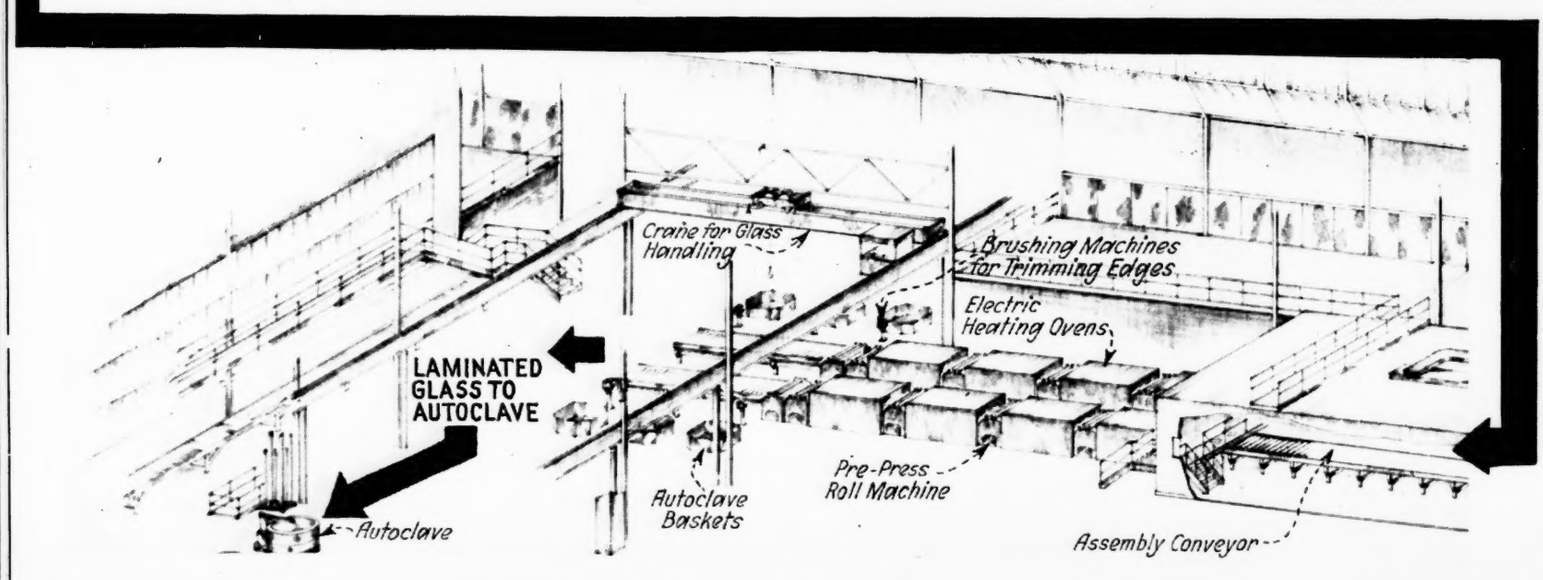
New Projects Authorized

An indication of the speed with which allocations are being made under the housing program now that the survey and site-selection machinery is in full swing, lies in the report of contract authorizations announced during the week ending January 22 by President Roosevelt. Under authority granted by the Lanham Act, the President declared an emergency need exists for 1982 dwelling units in eight defense localities.

The finding authorizes Federal Works Administrator John M. Carmody to proceed at once to provide 800 units at Norfolk, Va.; 100 at Hinesville, Ga.; 100 at Rantoul, Ill.; 200 at Brooklyn, N. Y.; 500 at Erie, Pa.; 200 at Orange, Tex.; 17 at San Antonio, Tex.; and 200 at Radford, Va. The foregoing list of authorizations is in addition to others previously announced for these locations, with a total of 9028 units as the probable requirements for construction during the year in these localities, either with public or private funds.

With the current status and the probable requirements of the defense program in mind, the evidence is ample that a busy year lies ahead for the heating and ventilating industry and its affiliates.





Schematic diagram of the manufacture of Ford High Test safety glass

PROFITS IN AIR

Ford Motor Company

has just installed the most complete and modern glass laminating plant in the world. Efficient handling of the Vinyl Resin used in laminating called for a complete installation of dehumidifying units. All of the functions of complete air conditioning are called into play in this installation.

JUST being put into operation in the Rouge Plant of the Ford Motor Company is the most complete and up-to-date installation in the world for producing High Test safety glass. In the manufacture of this glass a Vinyl Resin is used as a filler or binder between two sheets of glass. The character of this binder and the necessity of clean, dust free conditions for the several operations on both glass and vinyl preceding the actual lamination make a complete air conditioning system a practical necessity.

The process consists of passing the sheets of Vinyl Resin, received in large rolls, through a set of brushes to remove the excess of granular soda with which it is coated to prevent sticking in shipping and handling, then through the drying ovens to remove the intercellular moisture, and over a set of cooling rolls into the cutting room. Here after being cut to the size and shape of the glass to be laminated it is stored until needed.

The cut sheets are then passed through a continuous spray washer, first warm water and then chilled water sprays, to remove the remainder of the soda, then through a surface dryer to remove the surface moisture.

After inspection the sheets are carried by conveyor to the laminating room. The glass is brought by conveyor from the glass washers through cooler sections to the laminating room where the sheets are placed together with the Vinyl between, the same conveyor carrying it on to the prepress and final press operations.

The Problem

Vinyl Resin, used as laminating material, at ordinary room temperatures is limp and tacky, making it very difficult to apply to the glass. At temperatures below 65F it becomes fairly stiff and loses its stickiness. The material is also slightly hygroscopic, under humid conditions taking up enough moisture to be detrimental to the completed safety glass.

It is accordingly necessary for efficient operation to maintain a dry, cool atmosphere for handling of the Vinyl and its application between the sheets of glass. Since controlled conditions are not practical in shipping and handling the Vinyl, it is desirable to remove the moisture it may have taken up before passing to the cutting and laminating process.

After considerable study of operations it was decided, to obtain the best operating conditions, to design the system to maintain 65F and 15% relative humidity in the cutting room, 55F and 15% relative humidity in the Vinyl inspection and laminating rooms, and 142F and 5% relative humidity in the Vinyl drying ovens.

Storage and Brushing Room

The Vinyl storage room is not air conditioned, but fresh air is supplied through a 24 x 12 in. duct from a fan located on a balcony above. The air enters the room through a rosette type air inlet. The storage room is combined with the brushing room, where each of three brushing machines is fitted with an 8-in. exhaust duct. The air from the storage room is exhausted through these ducts into a 12 x 12 in. duct leading to a fan-washer unit on the balcony and thence to the outside. The washer removes the soda dust before discharging it. Exhaust air from the drying ovens is also washed by the same unit.

Drying Ovens

The Vinyl drying oven consists of a festooning conveyor enclosed in insulated sheet metal panels attached

THIS INSTALLATION

Designed by Ford Motor Co. engineers and glass technicians and Giffels and Vallet, Inc., L. Rossetti, Associated Engineers and Architects, Detroit, in close cooperation with each other.

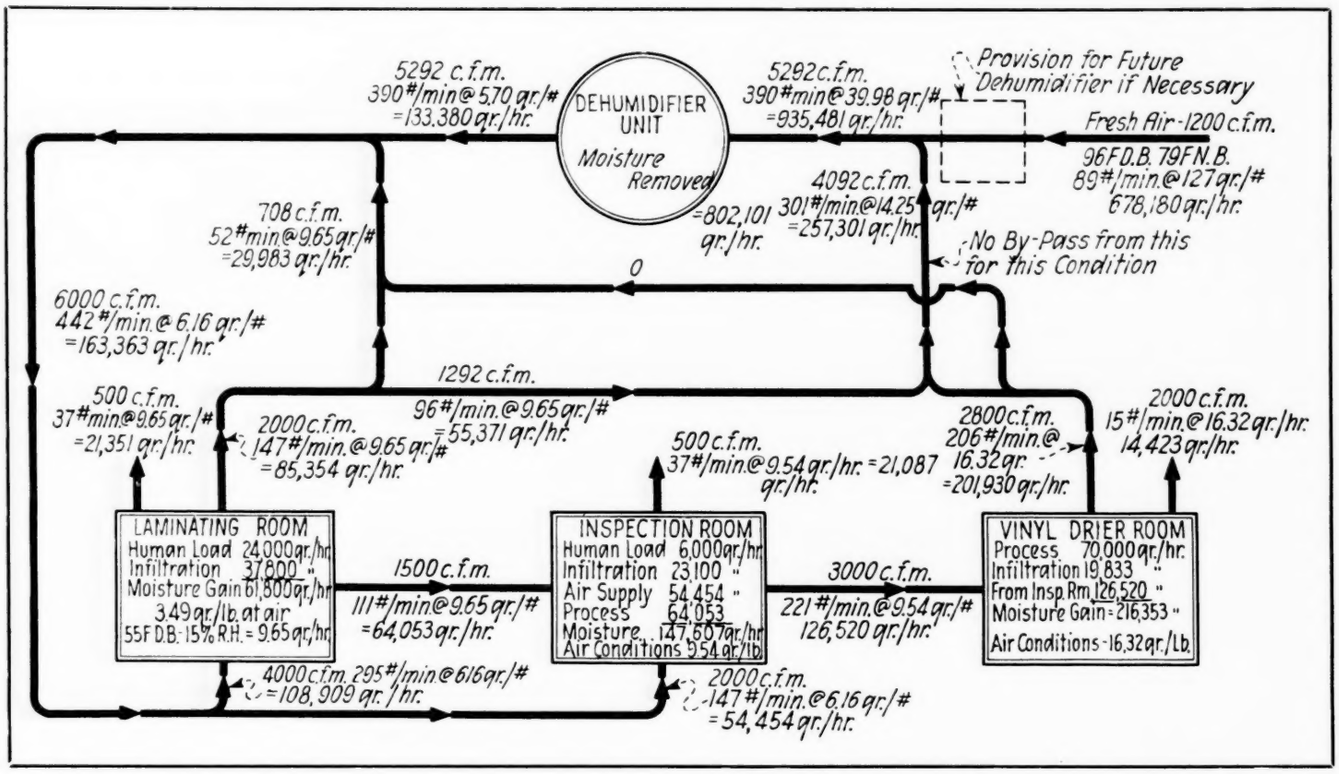


Fig. 1. Moisture balance diagram for the main dehumidifying system in the Ford Motor Company Glass Plant.

to a structural steel frame. The stainless steel rolls of the conveyor are driven in groups by variable-speed, direct current motors to compensate for the shrinkage of the material as it passes through the ovens.

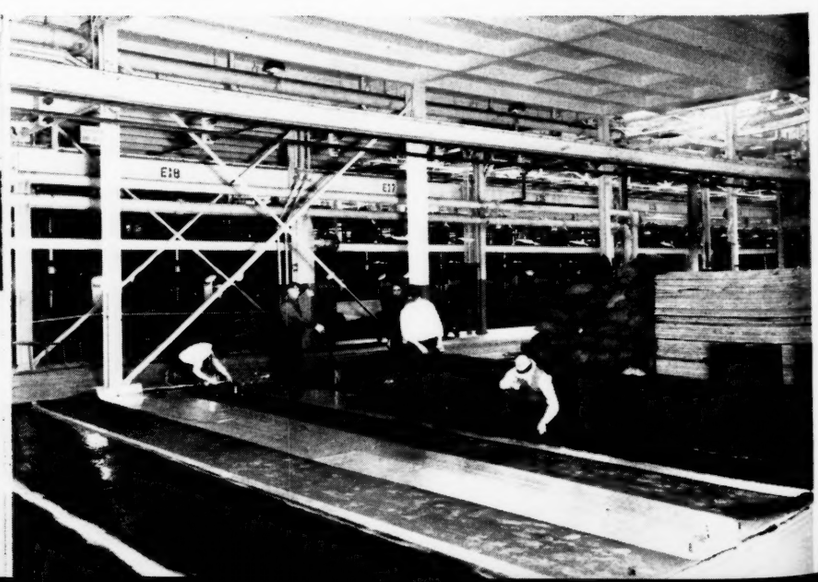
Air is circulated through the three ovens by standard turbine blower type unit heaters of 2000 to 2350 c.f.m. capacity, with steam coils maintaining the temperature. Humidity is controlled by supplying 400 to 500 c.f.m. of dry air from the dehumidifying unit in the cutting room system. All recirculated air is filtered to keep down dust accumulation in the ovens and on the coils. Control of temperature is by thermostat in the oven actuating a modulating valve in steam line. Humidity control is by a humidistat in the oven, controlling mixing dampers in the dry air and recirculated air ducts at the units. Excess air is drawn off by an exhaust fan with manual control dampers. Air is supplied to plenum chambers in the roof and floor of the ovens from which it is directed through nozzle slots between the festooned sheets of Vinyl and returned through grilles about mid-height of the side walls.

Vinyl Cutting Room

Air conditioning equipment for the Vinyl cutting room and laminating rooms is located on balconies adjacent to the enclosures and approximately at the elevation of the roofs of the rooms.

The conditioning equipment for the cutting room is designed to keep the room at 65F with 15% relative humidity and consists of a 6000 c.f.m. ventilating fan, a Pittsburgh Lectrodryer dehumidifier, brine coils, water coils, steam coils, filters, dampers, etc., 6000 c.f.m. of air is supplied to the room through ceiling Anemostats, assuming 550 c.f.m. exfiltration, while

Fig. 2 (left). Completing the roofs of the enclosures. Fig. 3 (right). Laying the felt and copper over the concrete floor, part of the process in vapor-proofing the enclosures.



5450 c.f.m. is recirculated through registers drawing the air over the cooling section of the festooning conveyor following the drying oven.

Humidity in the room is controlled by the amount of recirculated air returned through the dehumidifier or by-passed directly to the cooling coils, this proportion being controlled by a humidistat in the room actuating mixing dampers in the return and by-pass ducts. The air returned to the dehumidifier is mixed with tempered outside air. The amount of outside air supplied is controlled by a velocity regulator in the duct set to supply approximately 1500 c.f.m. It is necessary to limit the amount of outside air so that the mixture supplied to the dehumidifier will contain not more than 120 grains of moisture per pound of air, since at higher moisture content the air leaving the dehumidifier will not be sufficiently dry to maintain the required condition in the room.

All air supplied to the dehumidifier is double filtered to protect the alumina beds from contamination. Air leaving the dehumidifier is cooled to about 100F through a mill-water coil, again filtered and cooled to required temperature through a brine coil, the temperature being controlled by a thermostat in the room

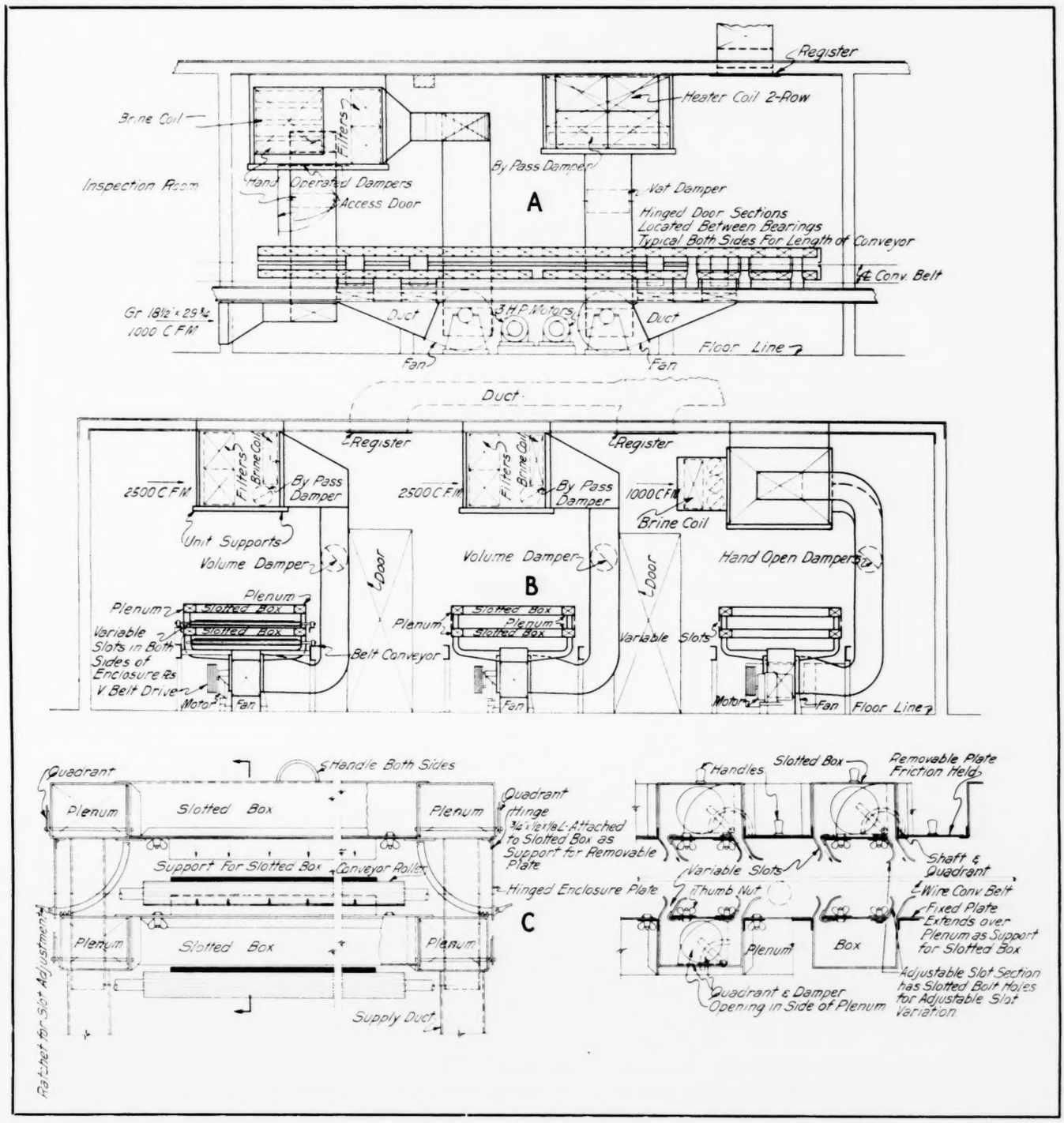


Fig. 4. Sections of the Vinyl drying units showing the method of introducing and exhausting the air around and from the dryers. In A is shown a side elevation, while B is a cross section across the conveyors. In C, at the left is a cross section detail; at the right is a section of C left at the point.

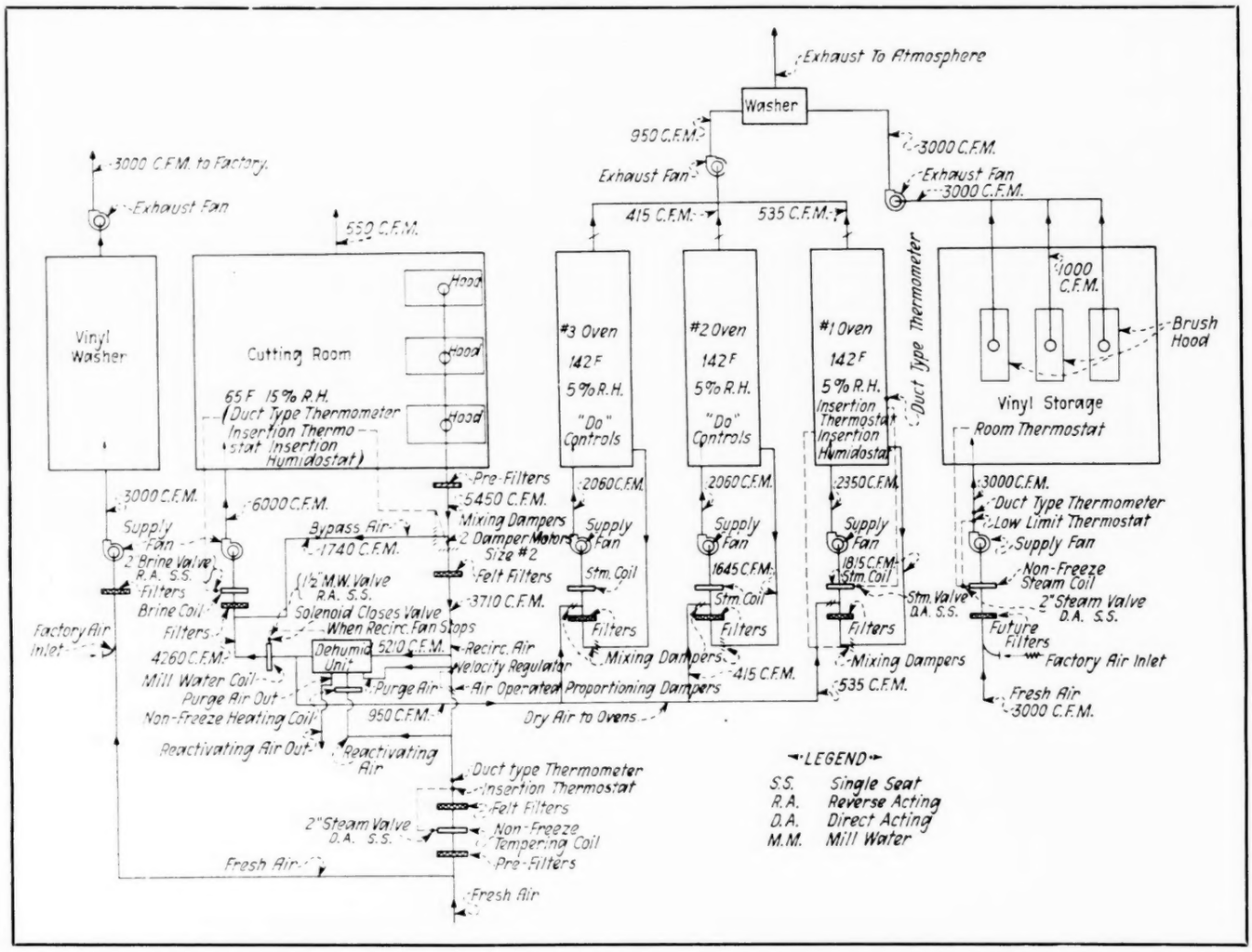


Fig. 5. Diagram of cooling, dehumidifying, and ventilation arrangement for the Vinyl preparation section of the laminating department. Refrigeration equipment by York Ice Machinery Corp.

actuating a modulating valve on the brine supply. A portion of the hot dry air from this dehumidifier is supplied to the units at the Vinyl drying ovens. Johnson Service Company controls are used throughout.

Filters are of the Kompak unit type, the pre-filters having a paper filtering medium and the final filters a heavy felt medium.

Brine is supplied from an existing refrigerating plant at 20F. All brine lines, coils, valves, etc., are iron to avoid corrosion should some ammonia escape into the brine system.

Vinyl Dryers

Vinyl dryers, for removing surface moisture after washing, consist of stainless steel, woven-wire-belt conveyors with plenum chambers above and below, completely housing the belt, and provided with adjustable nozzle slots to direct a blast of air on top and bottom of the sheets as they pass through on the conveyor. Two fans of 2500 c.f.m. capacity supply air to each dryer. The fan at the entry end of the conveyor draws air from the room through filters and a steam coil. Although the room air is relatively dry air from the inspection room, the steam coils are provided as a safety precaution to increase the rate of drying if found necessary.

The fan at the discharge end of the conveyor is designed to take 1000 c.f.m. of air from the inspection room and 1500 c.f.m. of air from the dryer room through a brine coil designed to reduce the temperature to 45F so that the air directed on the Vinyl in this section will be 50F or less, with the temperature of the Vinyl entering the inspection room not over 55F. Air supplied onto the conveyor is allowed to escape into the room.

Glass Coolers

Glass coolers are provided on each assembly conveyor line designed to cool the glass from 110F leaving the washers to 60F entering the laminating room. Each cooler is 35 ft. long and consists of insulated metal panels supported on a steel frame and housing in the conveyor. Top panels are hinged and side panels removable for access to the conveyor.

Plenum chambers are provided inside the housing above and below the conveyor with adjustable nozzle slots to direct the cold air against the top and bottom of the glass passing through on the conveyor.

For each cooler a 5000 c.f.m. fan with brine cooling coils and filters is mounted on a platform between the conveyors. The air is returned to the units from the housing around the conveyor, no make-up air being

supplied. In order to keep the air in the cooler at a low humidity to pick up any surface moisture that may remain on the glass from the washer and prevent condensation in the coils, a 1500 c.f.m. dehumidifier is provided and a portion of the recirculated air is drawn off, passed through the dehumidifier, and returned to the system. The amount to be returned to each system is regulated by a velocity regulator in the duct which actuates a volume damper.

Laminating and Inspection Rooms

The conditioning system for the laminating and inspection rooms is similar to the cutting room system, but designed to maintain 55F and 15% relative humidity. Provision is made in the arrangement to permit installation of an additional 1500 c.f.m. dehumidifier on the fresh air supply duct (which, incidentally, is now being installed on account of additional laminating line being added). It is the purpose of this dehumidifier to remove a part of the moisture in the fresh air supply so that the mixture supplied to the main dehumidifier will be low enough in moisture content that air leaving the dehumidifier will contain not more than 3 to 3.5 grains moisture per pound.

In this system 4000 c.f.m. is supplied to the laminating room and 2000 c.f.m. to the inspection room. From the inspection room 3000 c.f.m. is drawn by the fans on the Vinyl dryer, the excess, over the 2000 c.f.m. supplied to the inspection room, being drawn through the conveyor gallery between the laminating and inspection rooms. Recirculation to the dehumidifier and fan is through the dryer room. Since there is considerable moisture gain in the Vinyl dryer room the by-pass dampers are arranged so that all the return air from the laminating room is by-passed before the by-pass dampers in the return from the dryer room begin to open, so that a minimum amount of air is required to be passed through the dehumidifier. All air supplied to these rooms is filtered through felt filters to keep the rooms as dust free as possible.

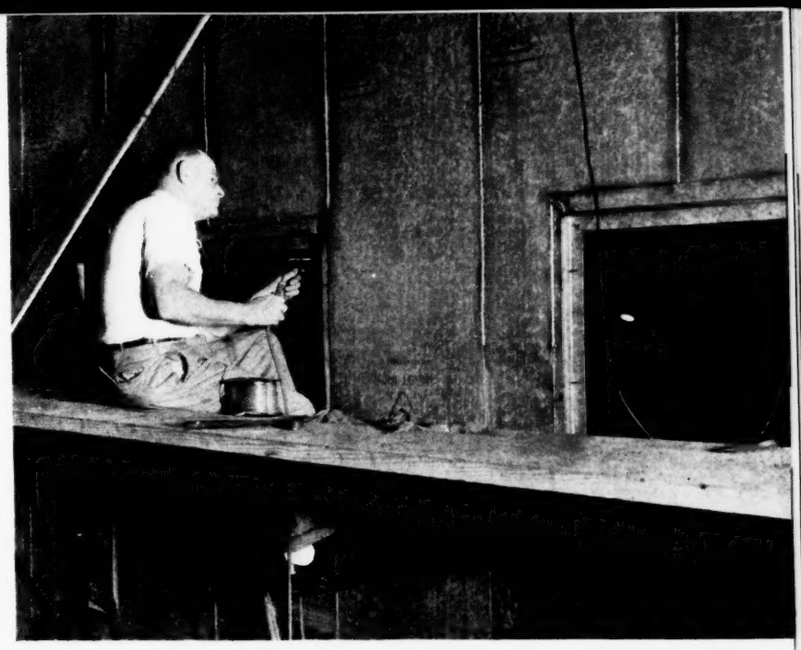
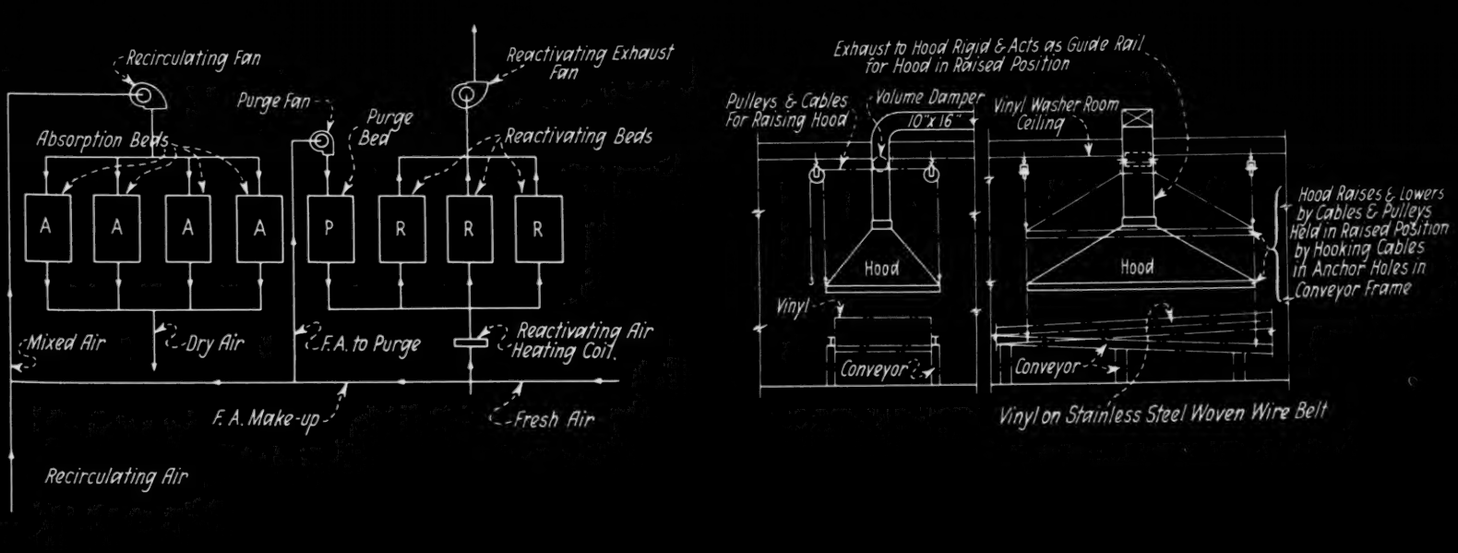


Fig. 6. All frames in the vapor barrier walls were sealed and all windows are double-glazed.

Vapor Proof Enclosures

On account of the low humidity required, extreme care was taken in the construction of the enclosures to prevent vapor infiltration. The existing concrete floor was first primed then covered with two plies of roofing felt mopped in place. Over this was laid thin sheets of copper and joints continuously soldered and a third ply of roofing felt laid over the copper. The walls of the enclosure are constructed of 2 x 4 in. studs with insulating boards on both sides and the space between filled with ground cork for high insulating value. The outside is covered with one ply of roofing felt mopped in place; over this a galvanized iron sheathing with all joints locked and soldered solid. The roof is constructed and insulated similar to the walls and metal seals are carried through the walls between conditioned and non-conditioned rooms. All windows are double glazed in removable frames and sealed with rubber gaskets, while vestibules and refrigerator doors are provided at entrances and exits.

Fig. 7 (left). Schematic drawing of the dehumidifier cycle for the cutting, laminating and inspection rooms. Fig. 8 (right). Cross section through the conveyor line at one of the Vinyl washers, showing exhaust hood and a longitudinal section through a Vinyl washer.



SQUARE D COMPANY

Industrial Controller Division, combines its Milwaukee headquarters and production facilities in an air conditioned single story building.

IN order to increase production capacity and efficiency, the Square D Company has transferred its Milwaukee offices and all production of the Industrial Controller Division to a new 125,000 square foot plant on North Richards Street at Capitol Drive. The offices are completely air-conditioned while the manufacturing area, laid out for straight-line production in two 60-foot monitor bays and three 40-foot low bays, is heated with projection type unit heaters.

The office section is finished in buff face brick and limestone combined in curves and angles with continuous projected steel sash to provide an impressive modern facade across the streamlined office section. The offices are air-conditioned and equipped with indirect lighting fixtures and skylights having concealed bulbs which are turned on by an electric eye to insure a minimum of 35 foot-candles at desk level when natural light falls below a given intensity. A basement extending under the entire office section will be utilized as a cafeteria for employees and for the storage of files and records.

A modern power distribution system which utilizes the company's own products to provide the highest possible degree of flexibility and efficiency is one outstanding feature of the new plant.

Forty-two hundred lineal feet of square electric duct has been used throughout the structure, including 500 feet in the office building where one installation serves the telephone system and another the lighting connections and office equipment.

Generous daylight is provided in the manufacturing portion through the 6-ft. 7-in. runs of monitor sash and 10-ft. 3½-in. runs of continuous side wall sash which completely surround the plant, while from 25 to 35 foot-candles of light is provided for night work by 500-watt Mazda lamps in standard RLM reflectors on 12 x 13 ft. centers. Vapor-proof fixtures are used in the enameling shop.

A view looking across the plant, showing the arrangement of assembly departments at one end of the structure, which has two 60-foot monitor bays and three 40-foot low bays. Projection unit heaters are used for heating factory space.

Heating

Thermostatically-controlled ceiling projection type unit heaters at 17 locations throughout the plant have a combined heating capacity of 5,638,000 B.t.u. and a blower capacity of 82,300 c.f.m. They are supplied with steam by two completely automatic oil burning boilers with a rating of 18,220 sq. ft. each. A separate oil fired boiler for process steam, rated at about 35 hp., meets the year-round requirements for hot water and process steam. Wiring for all electrical controls serving the automatic boiler equipment is carried in 4-in. square-duct, which eliminated the need for a maze of rigid steel conduit and provides ready access to all of the motors and control units that have been compactly nested behind the boilers. Oil for boiler operation is stored in two

PROFITS IN AIR

10,000-gallon tanks underground, which are connected to the building through a 30-ft. concrete pipe tunnel, 7 ft. wide. This is covered with planking and dirt. The oil is preheated for efficient combustion in a converter through which hot water and steam return lines pass.

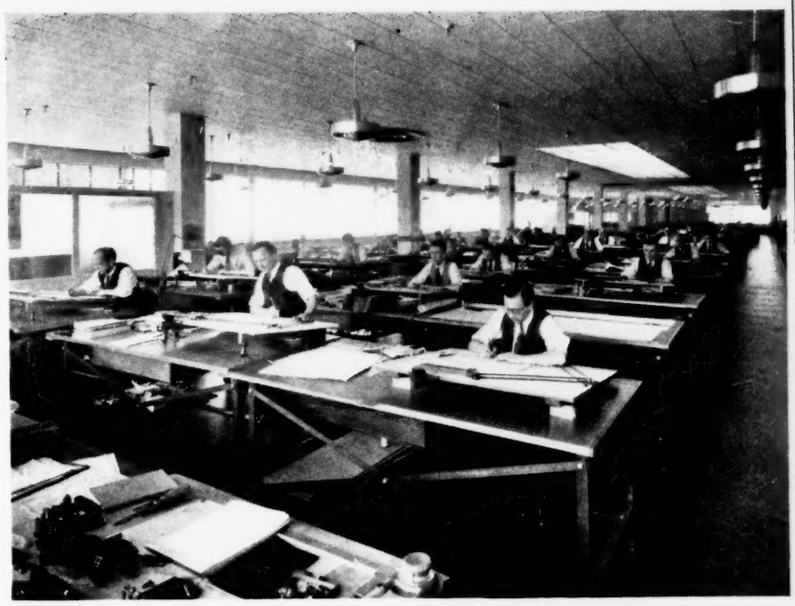
Air Conditioning

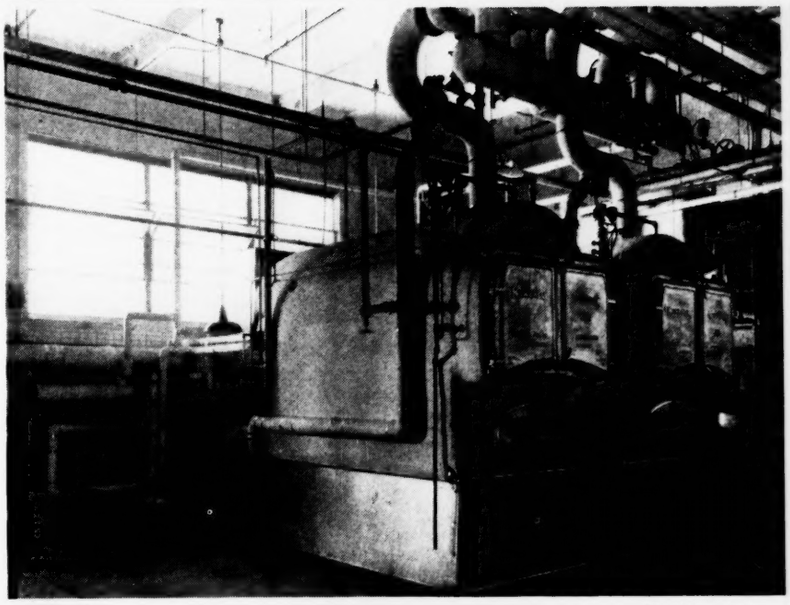
Two air-conditioning units, each of 9000 c.f.m. capacity, serving the office section, are situated alongside the wall which separates plant and office areas, and deliver conditioned air to the office. They use water pumped from a deep well at 50F for cooling. After it passes through the sprays in the air-conditioning chamber, this water is pumped to a standing pond on the office roof which substantially reduces the cooling load in summer. It overflows from the roof to pipes connecting with the lawn sprinkler system and is used for this purpose or wasted to sewers.

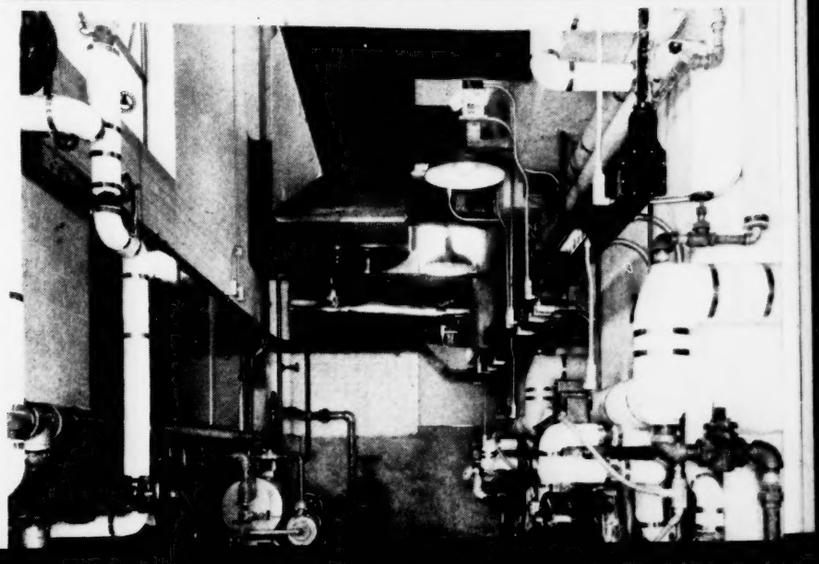
The plant has been laid out with a view to efficient production and in anticipation of the departmental expansion which would be required by future extensions. Wide column spacing was facilitated by the use of welded trusses used throughout the building. Incoming materials are received over a siding on the north side of the plant at the rear, directly adjacent to the boiler room, so that any type of fuel which might be used would be easily handled.

All of the departments housed in special rooms are located along the north wall beyond the siding and could be readily extended if expansion of the other plant facilities required it. The enameling room, 40 ft. x 120 ft., and a de-greasing room have equipment ventilated direct to the outside. Also located along the north side of the plant are testing department, compact experimental laboratory and blueprint room.

Engineers and Builders, The Austin Company



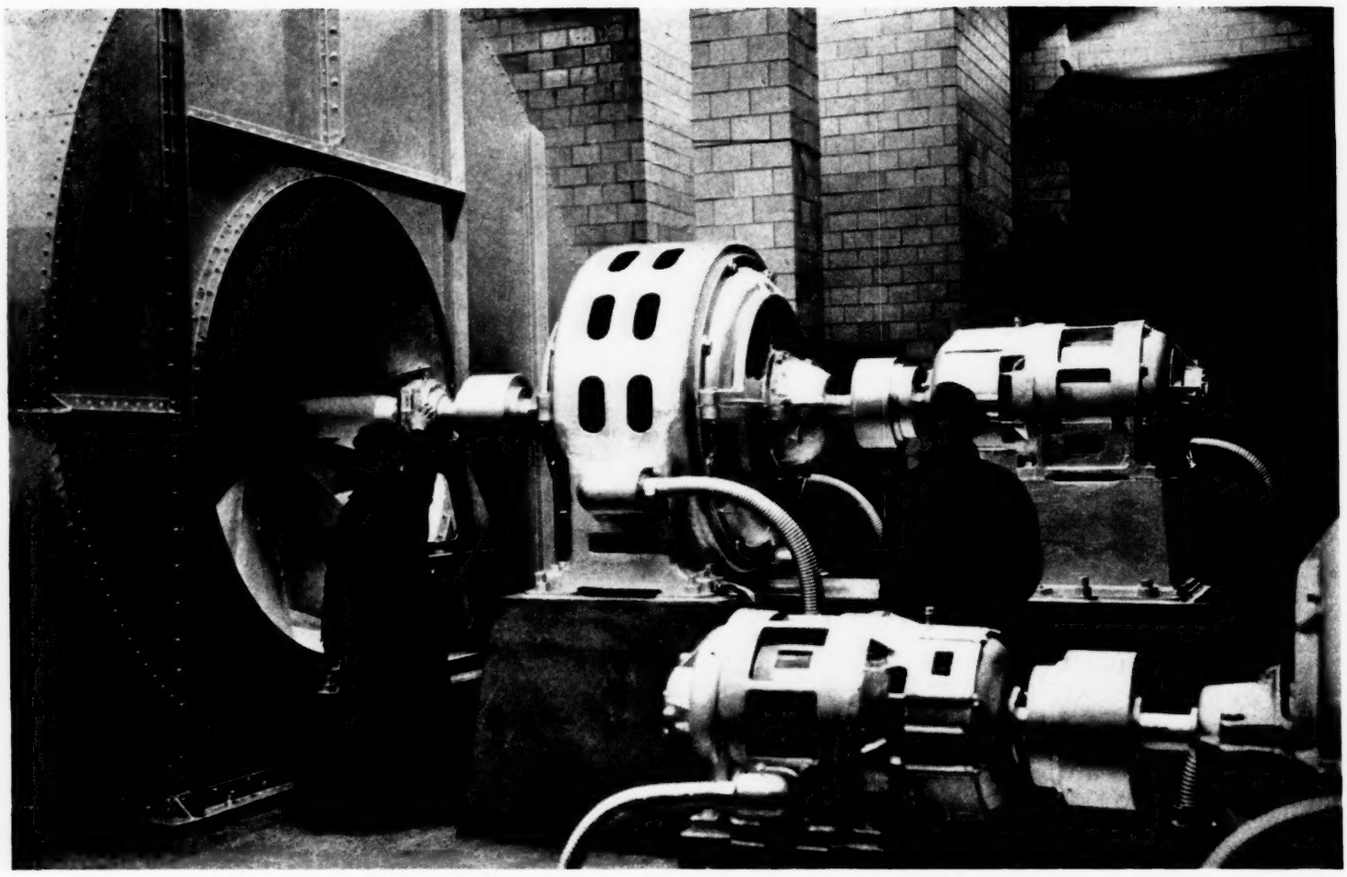




(Top) More than 125 persons are employed in the engineering department and general offices. The offices are air conditioned and lighted through continuous bands of projected steel sash and skylights.

(Center) Two completely automatic oil-fired boilers, with a rating of 18,220 square feet each, meet all heating requirements while a third boiler of 35 hp. rating has been provided for hot water and process steam (and can be partly seen on the extreme right). Controls for the boilers and the entire heating system are completely automatic and are compactly arranged in the area behind the boilers.

(Below) A four-inch square electric duct on three sides of this areaway between boilers (right) and the automatic control equipment serving them (left) precluded the necessity for a maze of conduit which would have reduced accessibility of the equipment.



Air Conditioning Maintenance Procedure

By FRED D. MOSHER

INTELLIGENT maintenance engineers not only follow a definite schedule in checking the condition of their air conditioning equipment but also have outlined, either in their mind or on paper, the best method of performing the various methods of maintenance operations and repair work. While intelligent maintenance procedure will eliminate nearly all emergency repair work there occasionally occurs a breakdown which can not be foreseen. The importance of having a preplanned procedure to take care of these emergencies can be readily seen. Even if the repair job is not an emergency one a definite plan of operation will help reduce repair costs. In the table is presented an outline of maintenance procedure for both central and unit type air conditioning systems. Simple tests are outlined where such tests are helpful for determining conditions and information is given on some recommended methods of procedure in doing repair work.

Ordering Replacement Parts

A very important phase of good maintenance practice is often overlooked—and that is when and how to order replacement parts. First the necessity for a replacement must be established. The builders of the apparatus should be consulted immediately when a failure of any consequence occurs; expert advice is available for the asking. If the part can be repaired, the manufacturer will be the first to say so. Sometimes it is cheaper to replace the part. In seeking information from the designers regarding repairs or replacement—give all the facts available. The part should be described in detail; all stampings such as class, serial number, and size should be included in the description. If the unit has been overloaded the builder will be most anxious to know. A brief history of the machine or part is entirely in order. There is nothing long-winded about such information; quite the contrary, it will hasten restoration of the unit to service. Insurance companies keep detailed histories of insured equipment, much the same as doctors keep accurate records of their patients.

Removing Scale

The construction of some types of heat exchangers of bent tube or coil design makes cleaning by mechanical means either impractical or expensive. In power plants such vessels, particularly evaporators, are *cracked* to remove scale deposits. Such methods assume a plentiful supply of high pressure steam. The vessel is then alternately heated and cooled which causes the scale to crack off. Thin, adhering scales do not respond readily to such treatment. A recently accepted method of internal cleaning involves the use of scale dissolving acids.

The acid solution is pumped under pressure through the coils, tubes, or shells. Hydrochloric acid, because

AIR CONDITIONING MAINTENANCE PROCEDURE

CENTRAL SYSTEMS

REFRIGERANT CIRCUIT AND CONTROLS—the part of the systems through which the refrigerant circulates including the compressor, connected piping and valves, condenser, receiver, and evaporator. The controls consist of such devices as thermostatic expansion valves, switches and regulators with automatic cut-outs and solenoid valves for water and refrigerant.

LEAKING GLANDS—When repairing compressors, valves and fittings, leaking glands should be tightened only to the point where the leak stops. If it is necessary to replace the packing, the system may have to be pumped down.

PUMPING DOWN—If the leaks are on the low side, the liquid line valve is closed and the compressors operated until a vacuum of 20 to 25 in. is reached. This forces the refrigerant into the receiver. In some cases where the system is to be open only for a short period it is possible to prevent leakage of air into the system, or leakage of refrigerant out by lowering the pressure to atmospheric pressure before the system is opened. After the repair is completed carbon dioxide may be used for testing for tightness. Where air is allowed to get into the system the system will have to be purged after operation is resumed. In making a repair to the high side of the system the refrigerant is pumped into the low side. In most cases it is not possible to pump all the refrigerant into the low side and therefore it is necessary to draw some of the refrigerant into drums temporarily. Only drums intended for such storage should be used.

REFRIGERANT STORAGE IN DRUMS—The drum is laid on a slant and connected to the refrigerant valve in the receiver with a flexible connection. The refrigerant flows into the drum by gravity. If the drum is kept in an ice bath, refrigerant will be speeded. The drum should be filled only to its stamped capacity. The amount of refrigerant in drum can be checked by placing the drum on a scale and noting the weight increase. After refrigerant is replaced and operation resumed the system should be purged.

PURGING SYSTEM—The best way to purge the refrigerant circuit is to first settle out the system to permit all foreign gases and air to rise to the high, or purging point of the system. With pressure on the system the purge valve is opened until refrigerant shows; it is then closed.

REPLACING REFRIGERANT—When additional refrigerant must be added to the system this is done by connecting a refrigerant drum to the suction side of the system in such a way that no liquid refrigerant can enter into the compressor. When conditions permit a warm bath around the drum will speed up the charging. The amount of refrigerant necessary can be determined by watching the head pressure.

SCALE TRAP CLEANING—System should be pumped down, if necessary, scale trap cleaned and the system should be put back into normal operation. After a short period of operation, air should be purged.

EXPANSION VALVES—To check the operation of expansion valves, the valve should be removed and connected to a cylinder of the refrigerant with the bulb hanging free. Refrigerant will be passed through the outlet of the valve when refrigerant drum is open. Placing the expansion valve bulb in the refrigerant stream should cause the valve to close.

MOISTURE—To remove moisture from the refrigerant a dehydrator of activated alumina, silica gel, or similar substance, should be installed. Dehydrators should be removed after about two weeks because they serve no purpose after the moisture has been removed.

SAFETY DEVICES—Fusible plug in liquid receiver should be renewed at least every two years. Relief valves can be tested by removing them from the system and checking them with compressed air or water. If water is used it must be perfectly clean and free from solid matter which might injure the valve. It should be noted whether safety devices of all types comply with local ordinances covering such devices. The operator should always be sure that protective devices will pass inspection.

CONDENSING WATER CIRCUIT—the part of the system through which the condenser cooling water circulates. It consists of condensers, water piping, floats and valves. If the water is recirculated it may include spray or cooling ponds, cooling towers, settling tanks, and collection pans; or it may include an evaporative type condenser.

STRAINERS—devices to catch foreign matter; they are often a protective device. Strainers should be examined for signs of wearing or warping in such a way that they might become an obstruction in the line. They must be kept clean.

VALVES—Periodical flushing with clean water under pressure is necessary to keep the valves clean even though strainers are placed ahead of the valves. When valves become pitted they should be ground in with a fine abrasive. After any repairs the water valves should be adjusted so that they close when the unit is shut down.

CONDENSER—Condenser should be cleaned mechanically once a year and thoroughly washed with clean water. Tools which are likely to damage the tubes should not be used, nor should the tubes be bulged. A cleaning "brush" should be used for mechanical cleaning. For prolonged lay-up periods condenser should be left completely dry on the water side.

TANKS AND PANS—Any tank and pan used in a condensing water system should be kept as clean as conditions will permit. During lay-up periods tanks should be first cleaned then laid up dry. Where tanks show signs of deterioration or corrosion, a coat of corrosion resisting paint should be applied.

EVAPORATIVE CONDENSERS—If ordinary flushing of the tubes does not completely clean them, other methods may have to be used. A caustic solution forced through a spray gun in which air pressure is used to spray, or in which steam is mixed with the caustic, will effectively remove stubborn scale. There are a number of commercial solutions, with caustic bases, which need no preparation other than the addition of heat. These solutions can be reclaimed and used again.

COOLING WATER SYSTEM—the circuit through which the refrigerated water passes. Includes storage tanks, evaporators, piping, spray units or washers, and collection pans and heating coils.

COOLING WATER—Water should be changed frequently otherwise it may develop odors that will be carried into the air conditioning spaces. In using deodorants, care should be taken to prevent an overdose. The pH concentration of the water should be watched to maintain it at the proper point. Addition of chemicals to the water may be necessary to establish the proper pH. Where slime persists in forming, even with frequent cleaning, a chemist should be consulted in methods of preventive treatment.

SPRAY NOZZLES—Nozzles must be kept clean. To do this, nozzles, or a complete bank of nozzles including the header, should be removed and blown out backwards with compressed air.

FILTERS AND DUCTS—the part of the system which cleans and carries the air of the system. Because of their structural nature they require less attention than other parts of the system.

FILTERS—Oil dipping filters should be cleaned with hot caustic solution; they are then washed with hot water or blown with clean, live steam. After cleaning they must be dried well. The oil dipping should give a thin film over all the surfaces after a period of draining to remove the excess oil. After cleaning filters should be thoroughly washed with clean water and dried and are then ready for dipping in an oil. Filters must be well drained before they are replaced in a filter bank. Throw-a-way filters should be replaced according to the manufacturer's recommendations or when static pressure drop is more than 0.25 in. of water. Dry filters should be cleaned according to the manufacturer's directions.

DUCTS—Ducts can be blown out but vacuum cleaning is preferred because of better control of cleaning. Unusually large accumulations of dust and dirt in a particular part of an otherwise clean duct may indicate improper contour at that point. Dirt-laden ducts mean poor filtering and washing.

DAMPERS—Dampers should operate smoothly, which means that piston drives must be free from air leaks that might cause sluggish operation. Dirty parts of such drives should be washed in a solution such as carbon tetrachloride to clean them. Orifices and parts should not be scraped since they may be enlarged by such treatment.

ROTATING APPARATUS—those parts of the air conditioning system, such as pumps, compressors, blowers, motors, and the controlling devices which convert or assist in the conversion of electrical energy into refrigeration.

COMPRESSORS—Only lubricants recommended by manufacturer should be used. Oil taken from separators should not be replaced in the system until it has been properly filtered. Packing glands should be tightened only enough to prevent leakage and only soft packing should be used. Where conditions permit, bearings should be opened once a year and the oil grooves cleaned out. Oil piping also should be cleaned. Cross head and connecting rods should be carefully checked for cracks and for signs of unusual wear. The whitewash test is highly useful for locating cracks. The part to be tested is first soaked in oil and then cleaned dry. Whitewash is applied and left to dry. After complete drying, the part is tapped with a hammer and oil will ooze from any cracks in the part and can be easily traced in the whitewash. Whenever possible, repairs should be made by welding.

BELTS—During long lay-up periods belts should be removed and wrapped in a protective covering. They should be stored away from the heat and in a dry place. No dressing should be applied unless specifically called for by manufacturer's instruction. Unusual wear of belts can be traced to misalignment.

MOTORS—Cooling air passages through motors should be kept clean. Broken brushes are an indication of high spots on the commutator. Motors should be kept covered when not in use. Starters on motors should have all contacts free from arcing during the starting cycle.

WATER PUMPS—Small water drips from pump packings should be disregarded. As a matter of fact many manufacturers specify this condition for good operation. Pump packing which is too tight may injure the shaft. When pump is to be idle for an extended period, packing on pumps should be eased off and all exposed parts should be covered with grease.

GEARS—Gear boxes should be well lubricated with the proper grade of oil. They should be washed out and oil renewed each year unless otherwise specified. Attention should be paid to the drives to see that they are kept in good condition.

UNIT AIR CONDITIONERS

UNIT AIR CONDITIONERS—self-contained air conditioning systems that are built in compact units.

PIPING—Flared joints in the piping or tubing should be protected from moisture formation by a coating of grease such as vaseline. Moisture which freezes will cause cracked nuts or flared ends of tubing and result in leaks.

MOTORS AND FANS—In replacing motor bearing oil, unless otherwise recommended, SAE No. 10 or No. 20 should be used on small motors. Cleaning of small motors is of considerable importance. Belt tension should be maintained at the proper point.

COOLING COIL—Cooling coil should be kept clean at all times since the dirt will not only reduce the efficiency but also may cause odors. Coils may be cleaned by washing with a caustic soda solution and rinsing with clean water.

CONDENSERS—Air cooled condensers should be cleaned frequently by compressed air. Tower type condensers may be cleaned by water under pressure.

AIR FILTERS—Air filters should be replaced when they become dirty and a static pressure gauge should be used to determine when filters should be renewed.

of its scale dissolving properties, is the acid commonly used. An inhibitor, of which there are several in common use, is added to the acid to prevent attack on the metal; water is added to the acid in the ratio of five parts to one part of acid, and the amount of inhibitor used depends on the kind being used and the quantity of acid. There should be nothing but ferrous materials in the circuit through which the acid is pumped. During the acid cleaning the temperature of the solution should be kept at about 120F-140F for best results. The acid should not be circulated over one-half hour; venting through the highest point in the apparatus should be done periodically during the cleaning to permit corrosive gases to escape. Sufficient mixture should be used to fill the space being cleaned and to provide constant suction for the pump. When the cleaning is completed the solution should be dumped to the sewer and clean water should be then pumped through the vessel and drained to the sewer until it shows clean; the circulating water is then made alkaline by the addition of soda ash and kept in circulation for about an hour, after which it is dumped to the sewer and the vessel is then flushed out with clean water. After cleaning, the vessel is thoroughly dried and kept dry while it is out of service. A pump that will handle about 100 pounds per minute at 100 pounds discharge pressure, a 50-gallon tank that can be made from a steel barrel, with the incidental valves and piping, are all that is necessary for acid cleaning of coils and other vessels.

Dipping of small coils in inhibited acid solution has been recommended. This will undoubtedly result in some cleaning of inaccessible surfaces, but the method of circulation under pressure is preferable. To summarize the procedure in acid cleaning:

1. All non-ferrous parts should be removed from the acid circuit.
2. The acid solution should completely fill all parts of the vessel being cleaned.
3. The acid-water ratio should be one of acid to five of water.
4. The amount of inhibitor used depends on the kind of inhibitor and the amount of acid being used.
5. The mixture should be kept at 120F-140F. At about 160F most inhibitors lose their effectiveness. At temperatures below these figures given, the action of the acid is slowed.
6. The acid solution should be circulated for one-half hour and drained to the sewer; the washings should also be drained to the sewer as their functions are completed. Following the acid circulation, alkaline water is pumped through the vessel for about one hour and dumped to the sewer; this is followed by clean water which is also dumped to the sewer.

For any given installation the first time the acid cleaning method is used, it should be under the supervision of a reputable chemist. His instructions should be sufficient as a guide for subsequent cleanings. Hydrochloric acid is commonly used because of its cheapness and its scale dissolving properties; it dissolves a larger number of different scale formations than most of the other acids, and it does so more rapidly. Its chief disadvantages are being more difficult to handle than other acids, and its fuming characteristics. Sulphuric acid is also used for cleaning purposes in the air conditioning industry, but as in the case of hydrochloric acid it should be used under the direction of a chemist qualified to do this work.

There are on the market several commercial solutions, using inhibited acids as bases, which are being utilized for cleaning air conditioning apparatus. These are well worth investigating leaving the decision to be made by cost and effectiveness. No acid cleaning mixtures should ever be put through a system while it is in operation, nor should such a solution ever be added to the circulating water.

There has been no intention in this discussion to indulge in overstatement nor to suggest that air conditioning equipment is rife with ills. It should be viewed as a summary of good maintenance practice based on the experience of air conditioning equipment operators and builders, designed to prevent unnecessary shutdowns when the smooth functioning of the apparatus is most needed. The methods outlined undoubtedly will not apply to all users; this is particularly true of the users of small "unit conditioners" and similar apparatus. It is estimated that about one-third of all the money to be spent for air conditioning equipment during the next five years will be spent for the smaller units. This leaves a preponderance of large units which will require more or less planned maintenance.

No mention has been made of steam turbine maintenance, although such drives are quite common. It is considered a very specialized field and should be given separate treatment. Turbo compressors have not been discussed because, as a rule, they are not subject to the common ills of the other types, nor do they, in general, require the same attention from a maintenance point of view. The treatment of the material has been aimed at the problem of maintenance as a money saver in overall operating costs. The question to be asked, then, is: What suggestions offered here will actually save dollars and cents? If the answer is in this discussion, its purpose has been served.

New Method Proposed for Computing Degree Days

A novel method of computing degree-days was recently proposed by Lee W. Stebbings, director of engineering and research and fuel service engineer for the Solid Fuel Institute of St. Louis, who has challenged the conventional method of computing degree days. The conventional method consists of subtracting the daily mean temperature from 65F where the former is less than 65F, the result being the number of degree-days for that day.

Mr. Stebbings' method is to divide the total hourly degree deficiency by 24, add the results for 24 hours, or one full day, and the degree-day is established.

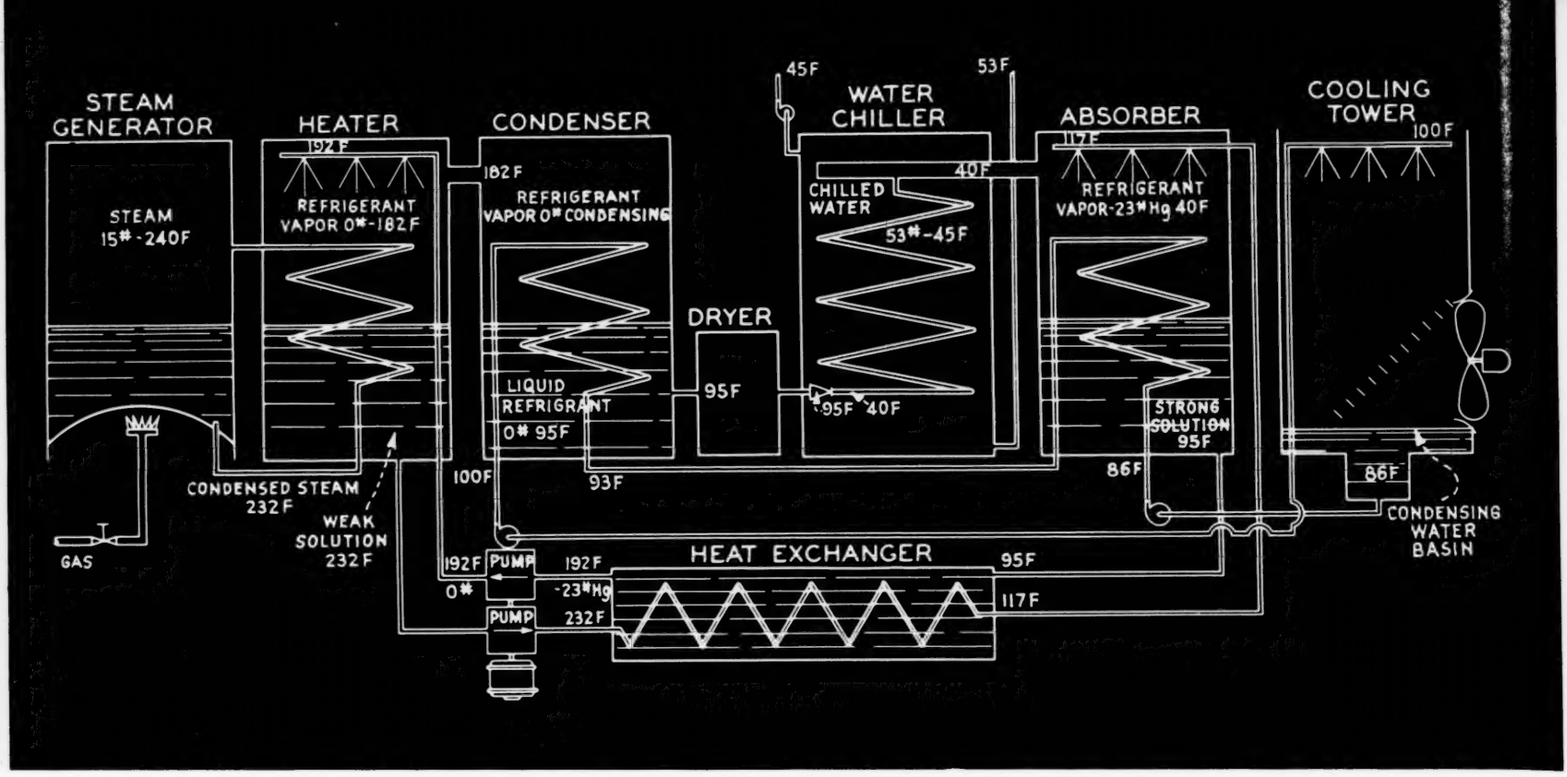


Fig. 1. Schematic diagram of one of the eight absorption refrigeration units which is used for cooling and dehumidifying at Tulane University Library. Steam is generated at 15 lb. pressure using gas as a fuel and the refrigeration unit supplies 45F water to the air conditioning equipment.

Absorption Refrigeration Used to Provide Cooling in Year-Round Conditioning of Library

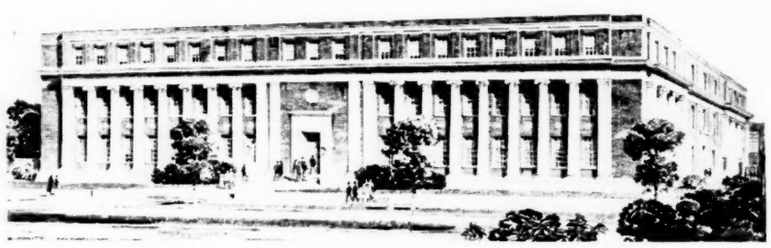
By G. ELMER MAY†

HOWARD-TILTON Library of Tulane University, a 3-story building 200 x 122 ft. in plan, uses steam for both winter heat and summer cooling and dehumidification. The gas-fired boilers generate low pressure steam for eight 35.2-ton Williams Air-O-Matic absorption refrigeration units.

These units are arranged in two banks of four—one bank being manifolded to supply 106 tons of refrigeration to the 7-level *stack* section of the building where the University's 250,000 volumes, rare manuscripts and fine bindings are housed—and the other bank is manifolded to deliver 126 tons of air conditioning to the remainder of the building where offices, reading rooms, and administration quarters are to be located. Either bank will be capable of handling 133 tons of refrigeration if need be; and both banks will be interlocked so that, if extreme emergency should ever arise, any part or all of the installation could be devoted to maintenance of required conditions in the stack section—where the condition of the books and collectors' items that make a library is the important factor.

For ideal preservation of manuscripts and bindings, constant year-round conditions of 80F dry bulb and 67F wet bulb (45% R.H.) are desirable. Breakdown of the glues and other materials used in bookbinding is caused principally by alternation of moisture conditions from excessively dry to moist and back again.

Essentially the Air-O-Matic units each consist of five hermetically sealed shell-and-tube heat exchangers and a small activated alumina dryer. The refrigerant, methylene chloride, and the solvent, ether-of-tetraethylglycol, are both extremely stable and liquid at atmospheric temperatures and pressures. The operation of the interesting absorption cycle is based upon the high chemical affinity that the solvent has for the refrigerant, and the fact that the solvent boils at a temperature considerably above that of the re-



Howard-Tilton Library of the Tulane University.

†Utilization Engineer, New Orleans Public Service, Inc.

frigerant. Steam at 212F is ample to distill refrigerant from mixture of solvent and refrigerant at atmospheric pressure. Since the refrigerant is actually allowed to evaporate at a pressure of 23 in. of mercury, it can be seen that the entire system operates at a vacuum, and leakage and loss of refrigerant are minimized. A standard absorption refrigeration cycle is used, the only connected equipment being the boiler supplying the steam, and the cooling tower. The cooling tower in this job is located in the rear yard, screened by landscaping.

Water delivered by each bank of four units will be held at 46½F for distribution to a filter-washer-duct system as diagrammed. The dampers regulating the ratio of cooled-and-dried to by-passed air are controlled by the humidistat, not the thermostat. This decision was made in view of the greater importance of latent rather than sensible heats in the New Orleans summer weather, especially in buildings where high human occupancy is the rule. As a matter of fact, with an almost identical installation in the New Orleans Public Service office building it has been found necessary on occasion actually to reheat in the summer time by bleeding steam into the winter heating coil after the required dehumidification function of the cold water spray has resulted in too great a cooling. This action, of course, is automatic with a system such as diagrammed.

Another unusual and ingenious feature to be incorporated in the Tulane system on the basis of experience with the New Orleans Public Service building system, involves controlling the temperature of the chilling water, not by cutting units in or out as the delivered temperature of the chilling water exceeds certain limits, but by cutting units in or out (with step controls) as the return temperature of the chilling water passes into ranges indicative of the load on the system.

By the usual method the delivered chilling water can be maintained only within a 2 or 3 degree temperature range, which in turn makes it difficult to achieve really refined relative humidity control in the conditioned spaces. However, by cutting additional units in as the return chilling water rises in temperature to indicate additional load on the system, added capacity is supplied before the delivered chilling water temperature has had an opportunity to rise appreciably—and that delivered chilling water temperatures may be held within plus or minus ½F all the way from no load to full system capacity.

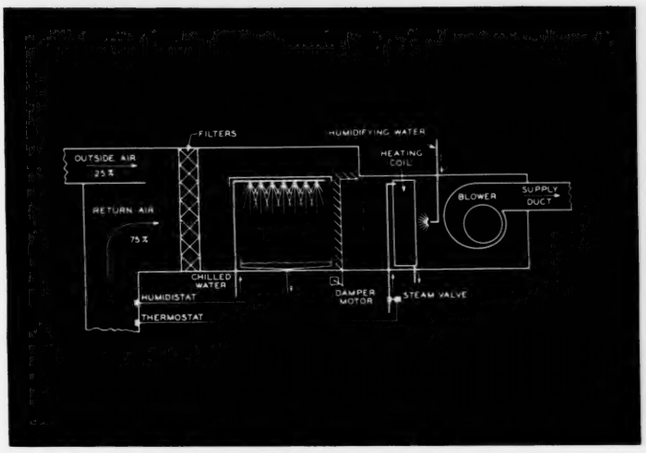


Fig. 2. Schematic diagram of the air conditioning unit used for year-round conditioning.

Advantages of the system include space conservation, no moving parts, flexibility, and efficient operation. With manifolded multiple-unit systems, the air conditioning plant may be operated with no loss in efficiency from zero to full capacity in steps corresponding to the capacity of a single unit.

Air Conditioning Helps Tulips Grow in Dutch East Indies

Tulip bulbs and lilies of the valley, formerly imported from Holland, today are being raised in tropical Java, Dutch East Indies, under identical climatic conditions found in The Netherlands, according to the International Division of Carrier Corporation.

A specially-designed air conditioning system, installed in the Van Telligen Flower Shops, has made possible this new industry in the Indies. Not only do they grow enough bulbs for home consumption, but now have built up a fairly large export business.

When war broke out in Europe, supplies of tulip bulbs and other plants from Holland were cut off almost completely. In addition, high cost of freight and import duties made the Holland-grown bulbs practically prohibitive. Van Telligen called in engineers and inquired if it were possible to duplicate the climate of Holland in Java.

After careful study, a specially-constructed storehouse of brick and concrete, using special insulation for walls, floor and roof, was designed. A low temperature Carrier air conditioning unit with an air cooled Freon compressor was then installed.

Extreme care had to be taken to see that the flower bulbs were not subjected to excessive drafts or air currents, which would have caused the bulbs to dry out. Furthermore, absolute control of humidity had to be maintained. High moisture might cause the bulbs to rot, while a high temperature with dry air might cause the flower bulbs to sprout while in storage.

Power for operation of the compressor, fan motor and electric controls was taken from the house lighting diesel engine set, which was operated only during the hours of 6 o'clock in the evening to midnight.

Air in the storehouse rises only eight degrees during the shut-down period, it has been found, due mainly to the large mass of cold flower bulbs in storage. This is ideal for flower bulbs, since they require regular "rest periods" at low conditions to attain best results.

Theory Vs. Practice

Size and Fuel Consumption

By T. W. REYNOLDS

IN determining the size of boiler the question often arises and seems never to have been settled as to whether the boiler size and the fuel consumption should be in accordance with the connected load or the required load as calculated and more often than not there is quite a difference between the two loads. Notwithstanding this past lack of determination the writer makes the following attempt to analyze the factors affecting this problem. This analysis, shorn of all whys and wherefores, may be boiled down to the declaration that both boiler size and fuel consumption should be based on the greater load.

If the connected load is greater, then the boiler must be sized for this load, because the boiler must be able to fill all radiators with steam. In other words, the boiler must be able to handle the connected load to make for more uniform heating of the occupied spaces. This is necessary even where the radiators are well distributed or in correct proportions throughout because, during heating up, each radiator does not ordinarily receive steam at the same time. A larger boiler will help out in this respect through its ability to decrease the time differential so that steam will be delivered to all points at practically the same time.

Where the radiators are not well distributed throughout, it is even more desirable to size the boiler for the connected load where this is greater. In cases of this kind an additional load is imposed on the boiler due to the excess capacity in such radiators as are oversize, for the radiators which are too large must be fully heated in order to insure full heating of the radiators which are smaller.

The boiler should preferably be sized for the required load when this is greater, though it should be pointed out that a boiler may be able, without any particular effort, to supply the heat loss from the structure at design load, say 70F inside with 0F outside, yet have less capacity than the so-called required load. The required load is one in name only, being merely the sum of the peak requirements of each heated space; peaks do not occur simultaneously, but vary one with another due to changing wind direction and sun effect. If, however, the boiler be sized for the required load, it will be a bigger boiler with greater pick up and more efficiency, tending to give more uniform heating. This is particularly desirable where the radiation is not well distributed.

Though the foregoing remarks are intended to apply more particularly to hand-fired coal boilers, they may nevertheless hold in the case of automatic systems, except where the conditions are most ideal in such systems. For example, in an automatic system, the house thermostat tends to govern and prevent any load in excess of the required load. However, this is true only where the system is adjusted by means of variable vent radiator air valves to the point where each room receives only the heat as required to offset the heat loss of that room at that particular time. Such refinements in adjustment are time consuming and are not always possible and where they are possible they are seldom done with proper refinement.

Fuel requirements of heating systems should be determined on the basis of the greater load in accordance with the same reasoning as outlined for determination of proper boiler size. With the connected load greater, there is a tendency in manually controlled systems to overheat where all or some of the radiators are oversize, especially so where the boiler size is equal to the connected load and therefore likely to override, while in automatic systems a lack of uniformity in the radiator sizes or in their rate of heating may bring about a certain amount of overheating. Estimates of fuel consumption for apartment houses should always be kept high to allow extras due to overheating.

If the required load is greater than the connected load, the fuel requirements should be estimated according to the required load since for practically all of the heating season the system will be able to meet the heating demands and use fuel accordingly. On the few remaining cold days of the season the boiler may be forced with waste of fuel, or where the radiation is improperly distributed, overheating of certain spaces will take place for most of the heating season.

The term "connected load" is used more generally in connection with electrical work, whereas in heating practice the customary designation for many years is "standing radiation," so named for no particular reason that the writer could ever learn. One might say that the radiators sometimes lay down on the job and should be hung, but generally speaking they stand on their own legs. Possibly this is what is meant by standing radiation.

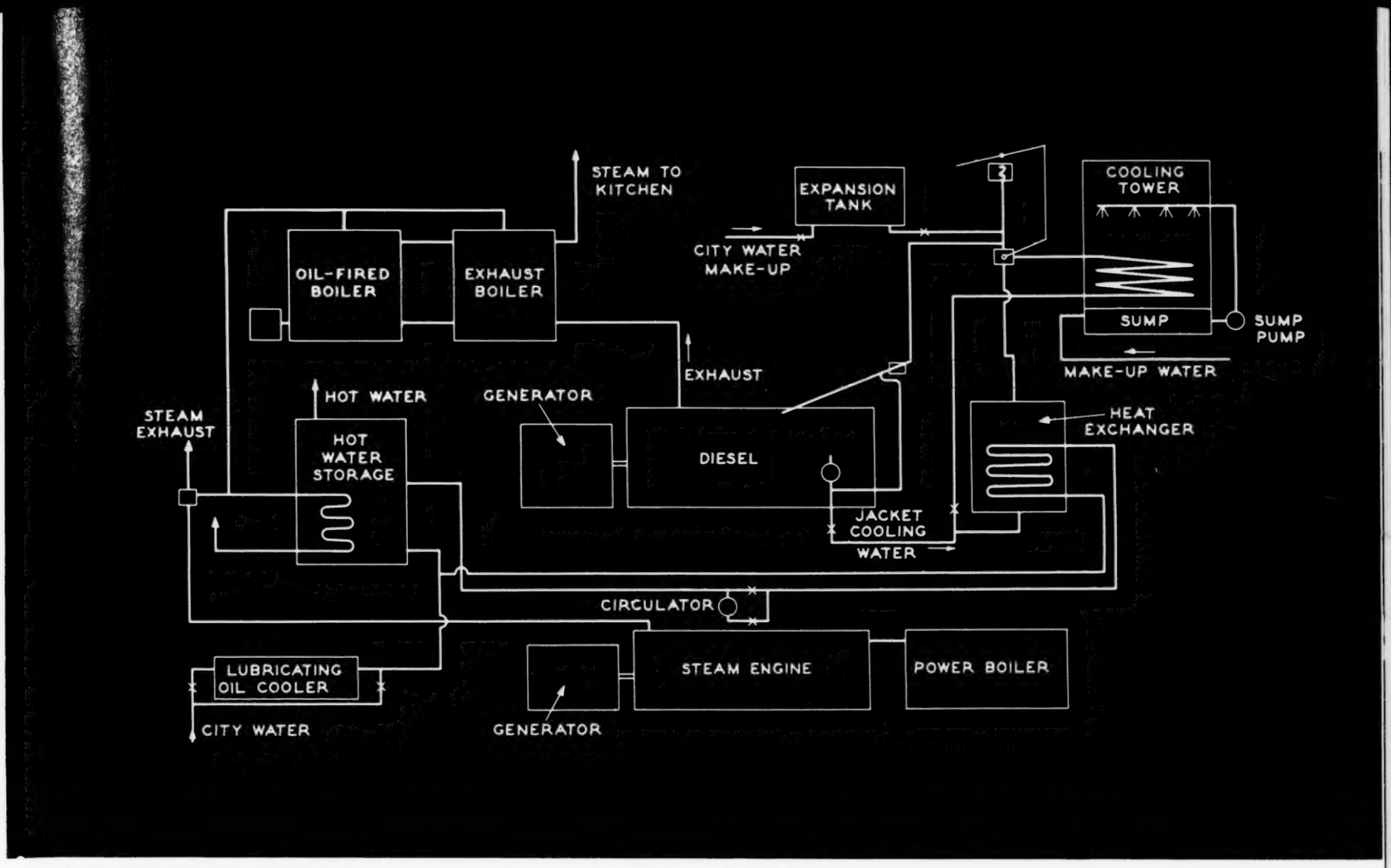


Fig. 1. Schematic diagram of the equipment used to produce power and heat for Atlantic Union College. Note the provisions for recovering waste heat from diesel and steam engines.

Waste Energy from Diesel Engine Supplies Heat to New England College

By FRANCIS A. WESTBROOK

ATLANTIC Union College, South Lancaster, Mass., has added a diesel-driven electrical generating unit to one which is steam driven and has arranged a system of piping connections for recovery of waste heat from both units whereby hot water worth some $350 has been provided during the three-month period between June 15 and the middle of September. As the diesel unit was operated at a load factor of only about 25% during this time it is expected that this saving will be greatly increased in the fall and winter months. During the same period the diesel generated about 30,000 kw. hr. of electrical energy at a cost of $625 for fuel and lubricating oil as against $900 for an equal amount of purchased power, at a flat rate of $0.03.

From the installation standpoint the most interesting feature relates to the means provided for the recovery of waste heat. The institution consists of some ten buildings grouped around a campus which need to be supplied with hot water and the kitchen with steam, and it is to provide these items that the waste heat is used. The piping connections between the steam and diesel generating units and the various items of equipment are shown in the diagram.

Hot water from the diesel engine jackets is circulated either through the heat exchanger or the cooling tower by means of the pump on the diesel. An Arco hot water damper regulator controls a three-way valve which directs this water either to the tower or the exchanger in accordance with the temperature of the water. That is, if it is at a higher pre-determined temperature than the exchanger can take care of the automatic control directs it to the cooling tower.

Loss of heat in the cooling tower is held at a minimum by having the diesel jacket water circulate through a coil near the bottom and suspended over a sump. The water in the sump is automatically maintained at a constant level by a float valve in the city water main. Cooling of the water in the coil is effected by means of forcing water from the sump through spray valves with a motor operated pump. This pump cuts in and out by means of the automatic temperature control which brings the cooling tower into operation when necessary.

Hot water for use in the various parts of the institution is stored in a hot water storage tank or supply tank. This water is circulated through the coil in the

heat exchanger by another motor-driven pump which is in constant operation so as to extract as much heat as practicable from the diesel cooling water and thus curtail the use of the cooling tower to a minimum. The hot water tank is also provided with a steam coil through which exhaust steam from the steam generating unit is passed when the latter is in operation.

In order to recover the heat from the exhaust of the diesel it has been found economical to install an exhaust boiler through which the exhaust gases are passed. Steam from this is piped to the coil in the hot water tank as shown in the diagram. There is also a steam line direct from the exhaust boiler to the kitchen.

This setup, however, does not provide enough steam under all conditions, even in winter when the steam engine is in operation, when, of course, the exhaust steam is also used for heating the buildings. In order to secure the requisite amount of steam to meet the hot water requirements a small, oil-fired boiler has been installed adjacent to the exhaust boiler. The oil-fired boiler is piped to the exhaust boiler so that the water in the two is always at the same temperature. If more steam is required than can be furnished by the exhaust boiler to keep the hot water tank at the required temperature thermostatic controls automatically start the oil-fired boiler, and of course it is shut off by the same controls. As will be readily realized, the fact that the water in the oil-fired boiler is at the same temperature as in the exhaust boiler provides for very quick generation of extra steam when the oil burner is placed in operation, and with maximum efficiency.

A final item in the heat recovery system is the diesel lubricating oil cooler. This is placed in the city water inlet line which supplies the hot water tank, so that the heat picked up from the oil is transferred to that tank, and salvaged.

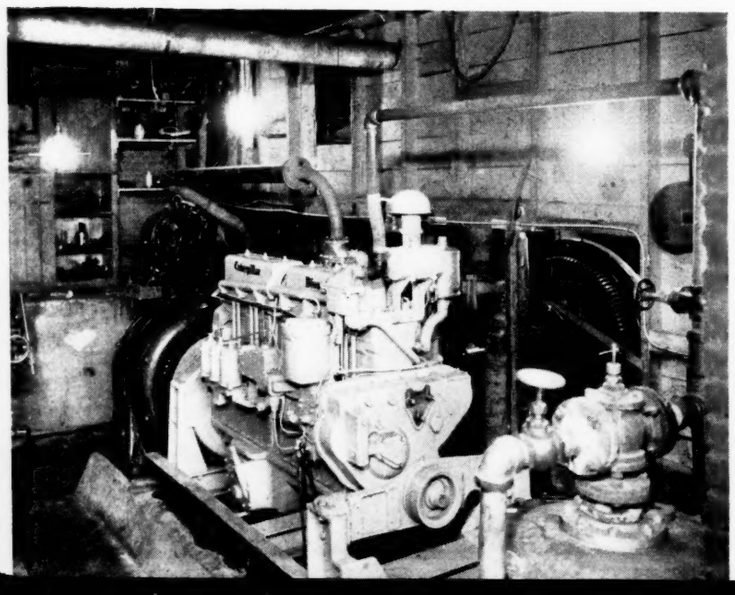
The present hot water tank has a capacity of only 450 gallons which means that it does not hold enough water to effect complete cooling of the diesel circulating water in the heat exchanger. That is why the cooling tower is necessary. An interesting side-light on the installation is that it is estimated that if the size of the hot water tank were increased to 1500 gallons it could take care of the cooling of the diesel circulating water and permit of discontinuing the use of the cooling tower with the heat losses involved. The present hot water tank dates from the time before the diesel unit was installed and as considerable expense had to be incurred to provide the setup as described it was felt that the larger hot water tank could wait until later. It will doubtless be installed before long and can easily be paid for out of savings.

This installation is an excellent example of the economies which can be realized by making use of otherwise wasted heat. As electrical power must be available for lighting and other services in this institution at all times the diesel unit is in operation 24 hours per day practically continuously. The steam unit is run only in the fall and winter months when low pressure exhaust steam is needed for heating the buildings and when the peak lighting load is heavier than can be carried by the diesel alone. During the heating season the diesel is to be operated only during peak load periods which it is well suited for as it is easy to start and can be brought up to synchronous speed very quickly.

Of course when the diesel is not running the circulator pump which forces the water from the hot water tank through the coil of the heat exchanger can be shut down as the diesel jacket water is not being heated. Or it may be kept in operation if the engineer decides that it is advisable to keep the jacket water warm in order to provide for quick and easy starting of the diesel. That is, by keeping the pump running the warm water from the storage tank will be circulated through the heat exchanger and keep the jacket water of the diesel warm, the cycle being the reverse of that when the heat exchanger acts to cool the jacket water. If the time of the peak load when the diesel power is to be added to the steam power can be foretold the circulating pump can be started up enough in advance so that the jacket water will be warm when it becomes necessary to start the diesel.

The College's engineer, R. M. Edmister, did the engineering on the job and supervised the installation. In order to keep down expenses he made use of the services of several of the students in the institution who, in turn, were helped in the financing of their educational expenses.

Fig. 2 (below left). Diesel powered electric generating unit which supplies both electrical energy and heat. Heat from the diesel jacket water and exhaust is used to supply steam and hot water to the College. Fig. 3 (below right). One of the ten buildings on the campus of Atlantic Union College, South Lancaster, Mass.



Economical Dust Control with Low Resistance Exhaust Systems

By F. F. KRAVATH†

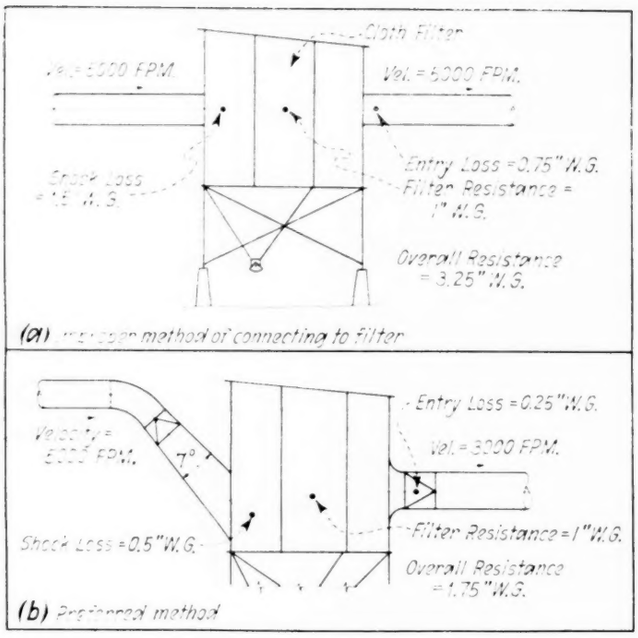
PART 4 — FILTER CONNECTION AND FAN SELECTION

So important is it that transformations be properly made in entering and leaving a filter or other cleaner with low filtering velocities, that some of the leading manufacturers of filtering equipment are either supplying or specifying the entry and exit connections to their filters, when they are called upon to furnish a guarantee for overall resistance of the unit. Whereas a well-designed filter may have a resistance loss across the filter medium of about one inch water gauge, this may constitute less than one-third of the overall filter drop. Yet by properly designing the elements under discussion, the picture is entirely reversed. The filter drop becomes the greater part of the overall loss by virtue of the low transformer losses. Illustrated in Fig. 8 are both an improper and proper method of making connections between pipes and filter. In "a," the duct velocity of 5000 f.p.m. is introduced into the relatively motionless filter air without any reduction in velocity. The result is that a violent piling-up of air occurs with the shock loss as high as a full velocity pressure, which in this case is approximately 1.5 in. W.G. After filtering the dust-laden air, the discharge to the fan is attached in the manner shown and very often without even any reduction in duct velocity. Since dust is no longer being conveyed, the velocity in this duct should not exceed 3000 f.p.m. unless the pipe size becomes prohibitively large, in which case a velocity as high as 3500 f.p.m. is permissible. In "b," we see one method of reducing the shock and vena contracta losses at entry and exit. With a 7-degree expanding piece as shown, introduced at an angle of 45 degrees so that material will not settle within the transformer, the shock loss at entry is reduced considerably. The longer the piece, the greater the reduction in shock loss since we then introduce air at lower velocity. The piece illustrated, which has a velocity at entry to the filter of 1500 f.p.m. has the extremely low shock loss of 0.5 in. W.G. At the exit, by using the bell mouth connection and the lower duct velocity, we are able to reduce the orifice loss to 0.25 in. W.G. Thus the overall filter loss has been reduced from 3.25 in. W.G. to 1.75 in. Where pipe sizes are relatively large, as above 24 in. diameter, it may be advisable for the sake of economy and appearance to transform from round to rectangular pipe and, keeping two of the nozzle sides parallel, so as to fit between the panel ribs of the filter, diverge the remaining two sides at an angle not exceeding 20 degrees. The loss of such a piece is not very dissimilar to the loss of the 7-degree round cone. At the exit, here again in order to fit between ribs, the bell radii in this direction may be made quite small, while the remaining radii may exceed the figures quoted in Fig. 3 slightly. Transformation may then be made from rectangular to round. While this piece may be made round without a great deal of difficulty, it does not lend itself as well to attachment to a standard filter body.

Most filters, like the other components of the exhaust system, the hood, piping, elbows, etc., are influenced greatly by the velocity characteristics within the filter. While the resistance of many varies as the square of the velocity for any given size of filter, it can be very definitely stated that all will increase with an increase in velocity, regardless of the rate of increase. Hence, it is important in selecting or designing a filter that it be properly sized, not only for performance, but for low resistance characteristics. To illustrate just how important this point is, the writer had occasion within the last year to enlarge a cloth filter which, with the passing of time had been called upon to handle more and more dust laden air so that the air to cloth ratio had become approximately 5 to 1, with a resultant resistance loss or drop across the filter of 3 in. water gauge. After enlargement, with a subsequent drop in the air to cloth ratio to 2.5, the filter drop was reduced to ¾ in. water gauge. (While the ratio was reduced from 5 to 1 to 2.5 to 1, signifying a doubling of cloth area, it was not necessary to double the size of the filter. More modern filtering designs accomplished the same result with scarcely more than an additional third.) Maxim (7) *It is false economy to scrimp on the size of a filter, savings in first cost will be replaced by increased maintenance costs and power consumption.*

The next item in the exhaust system which demands our attention is the fan. Here again, size is a prime consideration. A small fan, in order to handle the same volume of air that a larger fan can handle, assuming they are of similar designs, must run considerably faster. Assuming that both fans are capable of attaining the same efficiency as is usually the case with fans of a similar series, and assuming that the larger fan has been correctly selected for a certain job so that it is to run close to its maximum efficiency, then any attempt to make the smaller fan handle the same volume of air against the unchanged resistance must result in a drop in efficiency of the smaller fan from its peak. This follows from the fan law which states that for any series of similar or homologous fans operating at the same point on the efficiency curve or against the same unchanged resistance (and with air at the same density) capacity is directly proportional to the square of the

†Office Engineering Division, the Panama Canal.


Cloth Filter
Vel. = 5000 F.P.M.
Vel. = 5000 F.P.M.
Entry Loss = 0.75" W.G.
Filter Resistance = 1" W.G.
Overall Resistance = 3.25" W.G.
(a) Poor method of connecting to filter
Entry Loss = 0.25" W.G.
Vel. = 3000 F.P.M.
7°
Shock Loss = 0.5" W.G.
Filter Resistance = 1" W.G.
Overall Resistance = 1.75" W.G.
(b) Preferred method

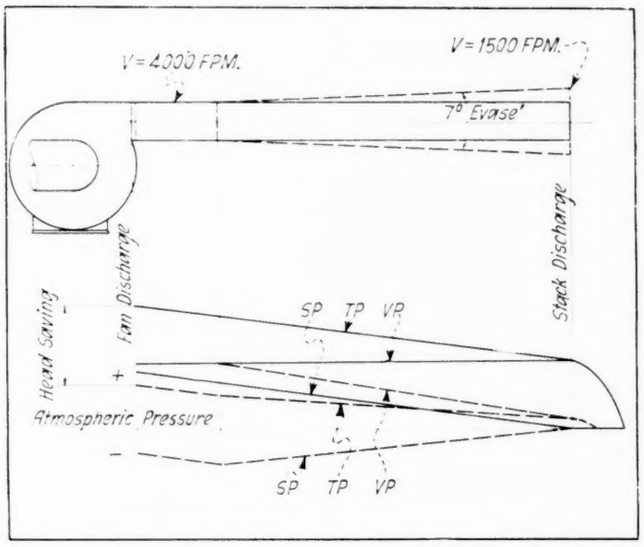


Fig. 8. (Left) Methods of connecting for filters and relative values. Fig. 9. (Above) Effect of diverging stack on total pressure or resistance.

diameter (of the fan wheel). Thus, for the same efficiency, a fan with a 24 in. diameter wheel can handle 4 times as much air as a fan with a 12 in. wheel, both operating against the same resistance. Also, since for the same head the fans are operating at the same tip speed, this means that the smaller fan already is revolving at twice the r.p.m. of the larger. In order to make it handle the same volume of air, it would have to run somewhere between 2 and three times as fast as its previous speed which would make it between four and six times as fast as the larger fan. (While the capacity of any fan varies directly as its speed, its head varies as the square of the speed, but in this instance it is desired that the head remain constant, so that the fan will assume a new operating point on its capacity versus head curve (at any certain speed) which will reduce the head as desired and boost the capacity as indicated. Thus, the speed of the smaller fan will be not four times its previous speed but between two and three times this figure.) Hence, it is very evident that size plays an important part in the proper selection of a fan if economy is to be one of our goals.

In the construction of fans there are many items which help to limit the attainment of perfect efficiency. One of these is the loss due to friction in the bearings. Here, it would be wise for the purchaser of fan equipment to insist on a high grade of ball bearing in preference to an unknown brand or inferior product of a known brand of ball bearing, or to the false economy of friction bearings. Another item which causes inefficient operation in fans is the loss due to leakage, for no matter how careful the design or workmanship may be, there must always be some leakage between the side walls of the casing and the wheel. This clearance offers a path for the return of air from the scroll casing to the suction. While in pumps, compressors, and turbines this is minimized by exact machine work, it is obvious that economy precludes this procedure in fan manufacture. However, it is very possible with accurately made fans to cut this loss down to a reasonable figure, and the purchaser of fan equipment would do well to investigate, among other things, the internal fan clearances. Shroud rings are effective in reducing these leakage losses, but good workmanship is paramount.

There are, besides the losses caused by the frictional resistance of the air moving over the fan parts, losses termed as shock losses. These losses due to the violent change in direction at the inlet of the fan where the air is turned through an angle of 90 degrees, and the impact of the fan blade with the air at this point are always present and at best can be reduced only slightly. However, a slight gain in efficiency is worthwhile when handling large volumes of air. There are various methods employed to reduce these losses, among them being the use of inlet guide vanes which give the air passing through the inlet of the fan an initial twist in the direction of rotation so that the shock loss experienced when the fan blades hit the air is considerably reduced. However, there is a resistance loss through this twister, which tends to reduce the overall gain in efficiency. Another effect of this twister is to reduce the capacity of the fan somewhat. Employment of curved blades is also made in reducing the shock loss at blade impact, and, since this is quite successful, the purchaser of fan equipment would do well to investigate this point. However, in all cases where the fan is to handle only clean air, the writer recommends either the forward curved or backward curved blade fan for greater efficiency. While the former is not quite as efficient as the backward curved blade fan, and has the added disadvantage of being subject to *hogging* or motor overloading with an appreciable drop in system resistance (such as a line break or leak close to the fan might cause), it is smaller, cheaper, and requires less space or cheaper supports. Frankly, the writer has found that the added cost of the backward curved blade fan is well worth the gains in efficiency, the greater structural strength, and the general ruggedness and smoothness of operation of this fan. The fact that this type of fan is much better adapted to handle higher static

pressure is of interest, but not overly important, since this article points the way for the reduction of most system resistances to well within the range of even the forward curved blade fan. Since the variation of fan efficiencies ranges from 30% to 80%, maxim No. 8 follows—*It is essential in order to secure the most efficient fan that we carefully select the proper size, the most efficient type, and the best workmanship.*

One of the elements making up the exhaust system which rarely receives the attention it deservs is fan discharge or stack. It is possible to do some really remarkable things with this piece. For instance, a long stack, if necessary, can be so constructed that it adds practically nothing to the total pressure against which the fan must work, or, if no stack is necessary, by the addition of a well designed stack of proper length an actual reduction in total pressure can be achieved. All this is done by the efficient conversion of velocity to static energy by the use of the 3- to 7-degree included angle evase stack. In Fig. 9 is illustrated a straight and diverging stack and the pressure graphs corresponding to both. The lines correspond to the conditions for the straight stack while the broken line curves represent the diverging stack pressures. Referring first to the curves for velocity pressure, it is noticed that for the straight stack the velocity pressure is constant from fan discharge to stack discharge, tapering off parabolically from there to atmospheric pressure. For the other stack, the velocity pressure is constant through the straight section and then decreases to the value corresponding to a velocity of 1500 f.p.m. at the stack discharge, and then to atmospheric a short distance beyond this point. Since the velocity pressure and total pressure are identical at the stack discharge, the difference in levels between the total pressure curves at the fan discharge and stack discharge represents the actual resistance between these points. It is interesting to note that in this example the static pressure throughout the entire length of the stack is negative, which suggests the possibility of a duct connection at this point with consequent inward flow of air. This duct must, however, represent only a small fraction of the total discharge duct volume. The example shown would represent a head saving of at least ¾ in. water gauge, while the saving would be even greater where the discharge at the fan out of necessity had to be above the maximum figure of 4000 f.p.m. shown.

[*In the next installment the author will show how to calculate a sample system.*]

Sterile Air a Necessity in Serum Laboratory

In a picturesque building near the shores of Lake Michigan a few miles southeast of Grafton, Wisconsin, are the laboratories of the Fromm Brothers-Nieman Company, Hamburg and Thiensville, Wisconsin. Serum and vaccines to prevent distemper and encephalitis, the two most prevalent diseases of fur bearing animals, are produced here. These products and the research facilities of the laboratories are available to the nation's fur raising industry.

Air conditioning plays an important role in facilitating the conduct of research and the preparation of vaccines and serums. The air must be maintained as sterile as possible. Bacteriological plants of this sort are under government inspection and air conditions are constantly tested by means of bacteria culture plates which are exposed to the atmosphere for a certain length of time and then examined under a microscope. Government regulations permit from three to five colonies of bacteria per person per square inch. Bacteria tests are made daily, with the average test revealing a bacteria count of less than one colony per person per square inch. Air conditioning has enabled the Fromm Brothers-Nieman Company to maintain conditions from three to five times more sterile than even government regulations require.

The laboratory is completely heated and air conditioned with a vertical air conditioning unit which has a capacity of 2,000 c.f.m. and is equipped with a six-row direct expansion coil, filters, and a target spray humidifier. Because of the absolute necessity of keeping the building as sterile as possible, 100% outside air is used. This outside air is induced through an automatically controlled steam distributing tube blast coil, where it is heated to a constant temperature of 60F. The air then enters the air conditioning unit where it is humidified during the winter cycle and is discharged into three zones—the basement and the north and south halves of the first floor. The temperature in each zone is controlled by automatically regulating booster coils which are placed in the duct leading to each zone. A 7½ hp. reciprocating compressor is employed during the cooling cycle. A humidistat starts and stops the compressor in order to maintain a constant relative humidity, while the booster coils are used for reheating where necessary. Accurate year-round temperature and humidity control is achieved.

The air is delivered to each room through ceiling outlets which are so arranged that air is also removed through them by means of a 15 in. blower type exhaust fan. The fan handles the same volume of air as the air conditioning unit and positively removes air from the conditioned area. Design conditions for the cooling cycle: 80F D.B. and 67F W.B. with outside conditions of 95F D.B. and 75F W.B. Heating cycle: 70F D.B. and 40% R.H. with outside temperatures of —15F. The individual zone thermostats governing the booster coils arrange to reheat in case the dry bulb temperature becomes too low. All of the controls are so arranged that any time the air conditioning unit is turned off, the automatic dampers in the fresh air supply and in the exhaust duct are closed, the compressor and exhaust fans cease operation, and the steam and water valves are closed.

The architect and engineer was R. H. Bierman, while the contractor was the Downey Heating Company.—*Fred Pederson.*

Auditorium of Proctor's Theater, Troy, N. Y. Conditioned air is distributed by Anemostats under each of the balconies, and by a large Anemostat in the ceiling of the auditorium (not visible above).

HOW order was brought out of a maze of old ventilating ducts—some of which had never actually been used—and an economical system of air conditioning installed in Proctor's Theater, Troy, N. Y., is an interesting demonstration of what can be accomplished by the application of modern methods of air conditioning and up-to-date equipment.

Although comfort air conditioning cut its eye teeth in theater applications, there are still a great many Class A houses that do not yet have comfortable, effective air conditioning. The initial investment is invariably the primary obstacle to theater owners. What the owners may not fully realize—and what Proctor's installation illustrates—is the fact that the cost of air conditioning has been greatly reduced. Proctor's, for example, was air conditioned for 37% less in 1940 than it would have cost a few years ago when the building was surveyed for air conditioning. And because of certain economies in the use of electricity, the operating cost is but little more than that of the old ventilating system alone.

The installation was designed by J. W. Elmendorf, engineer, of Westover-Wolfe, Inc., heating and ventilating engineers and contractors, Albany, N. Y. The contract was awarded in March, and the system completed in plenty of time to provide a full season's operation. Fortunately for the contractor and his engineer, Proctor's Theatre is managed by a man who had previously been in charge of several other theaters which installed air conditioning. Consequently, he was fully conversant with the problems of designing a satisfactory system for an existing theater building.

A set of the original building drawings was available, which saved the designer many hours of survey and layout work. The blueprints also permitted accurate calculations of the volume of the theater, the figuring of heat gains, and most valuable of all, they disclosed important data on the size and location of the existing ventilating duct work.

The theater is arranged with about 1400 seats on the main floor, 300 on the mezzanine, and 600 on the balcony. The ceiling height under the mezzanine averages about 11 ft. Under the balcony the ceiling has a very steep pitch, with an average height of 12 ft. The balcony ceiling varies from 10 ft. at the rear to about 50 ft. in the front, and the overall ceiling height in the center measures 87 ft.

Existing Ventilating System

Three blowers had been installed for heating and ventilating purposes. The first blower was enclosed in a penthouse on the side of the building, and served to remove smoke in the balcony. A six-foot space between the mezzanine ceiling and the balcony was being used for an exhaust chamber. A second exhaust blower in the organ loft on the opposite side of the theater was connected by a duct system to the rear of the balcony. Evidently the purpose of this blower was also to exhaust air from the first floor in front of the orchestra pit, because there was a gypsum block duct from the blower room to the basement and a brick duct under the orchestra pit. However, this had been bricked off at two points and apparently had never been used.

The third blower was installed for the heating system and was located in the basement next to the boiler room. One hundred per cent fresh air was taken from an alley, heated, and then delivered to two plenum chambers and several small outlets in the offices, lobby, rest rooms, etc. Both plenum chambers were equipped with mushrooms caps, one chamber being located under the entire first floor, the other under the mezzanine floor. The duct work to the plenum chamber under the mezzanine was furred in between two pilasters on either side of the theater. This duct was originally connected to a third plenum chamber between the mezzanine and the balcony. This extension was never used, however, the duct work having been cut off at the mezzanine floor to provide space for the exhaust system described above.

All in all, the old ventilating system was quite a tangle. For example, it never was quite clear why air entered a grille on the floor of the first floor foyer, and

Installation Costs 37% Lower

than a few years ago, Troy, N. Y. theater installation shows. Operating costs are only slightly higher than for old ventilation system—By S. MARTIN, JR.†

then came out of a grille on the second floor, when both outlets were on the same duct. At any rate, it was decided to use all of the existing duct work, as well as the mushroom caps on the first floor and the chamber under the first floor, for our return system.

Location of Equipment

This fixed the location of the apparatus under the stage and presented another problem. The space was divided into a boiler room, blower room, switchboard room serving the theater and a large office building, a storage room, a motor-generator room, and orchestra room, another blower room for the organ blower, and a passage-way. In one corner of the storage room was a room containing the organ mechanism, connected to the organ by hundreds of wires which made moving it practically impossible.

The designer made a layout of the basement, exclusive of the first three rooms which could not be used, and cut templates of the equipment to be installed. This layout was made on a large scale and revised and revised until finally the equipment, as laid out, fit in the basement perfectly. It was necessary to remove several partitions and use two blowers, two conditioners, and two sets of filters in order to avoid excavating. The equipment had to be shipped knocked down and installed one piece at a time. As can be seen from the progress pictures, very little clearance was allowed, and it was fortunate that the apparatus could be installed as planned. The large conduit shown in the picture of the blowers contains the electrical cable for the two condensing units. This conduit, of course, had not been installed in the theater prior to the installation of our equipment and very nearly necessitated excavation in order to get clearance for the blowers.

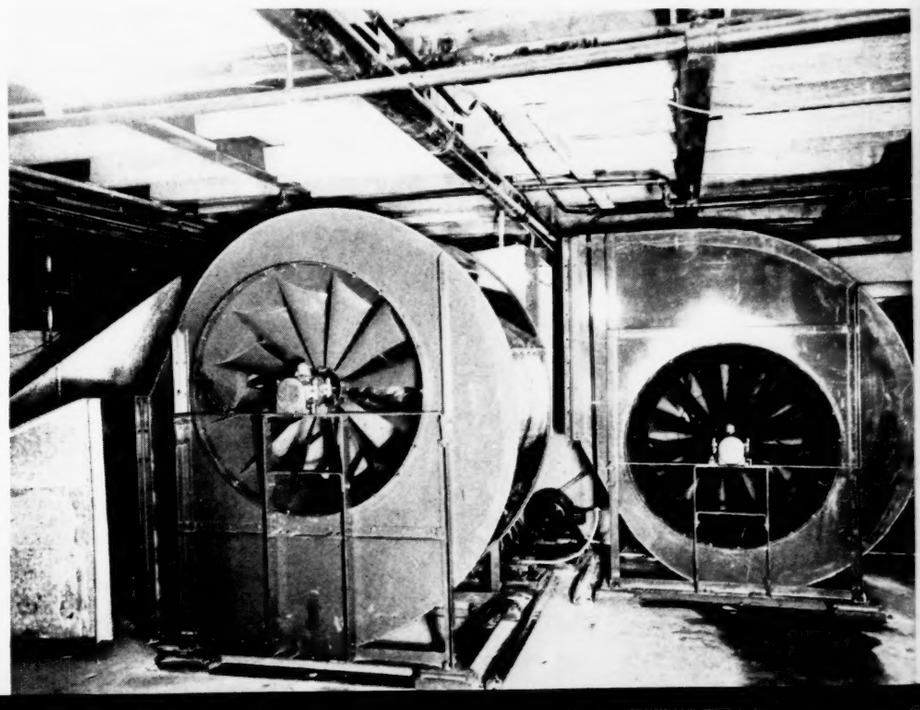
Strange Noises from the Organ

Before the duct work could be installed the organ supply ducts had to be moved. This work was accomplished at night and had to be completed by ten o'clock the following morning so that a radio broadcast could be made as scheduled; therefore, only as much work as could be finished in one night was attempted. That morning the organist appeared for rehearsal a half-hour before the program went on the air. After fifteen minutes of rehearsal the organ suddenly groaned and began to sound like a run-down victrola record. A duct connection made the night before had broken! To repair the damage, the joint was pushed back together, a couple of towels, tied together, were wound around the duct and twisted tight with a stick to complete the *first-aid* treatment. This was held in place, and the broadcast went on the air as usual.

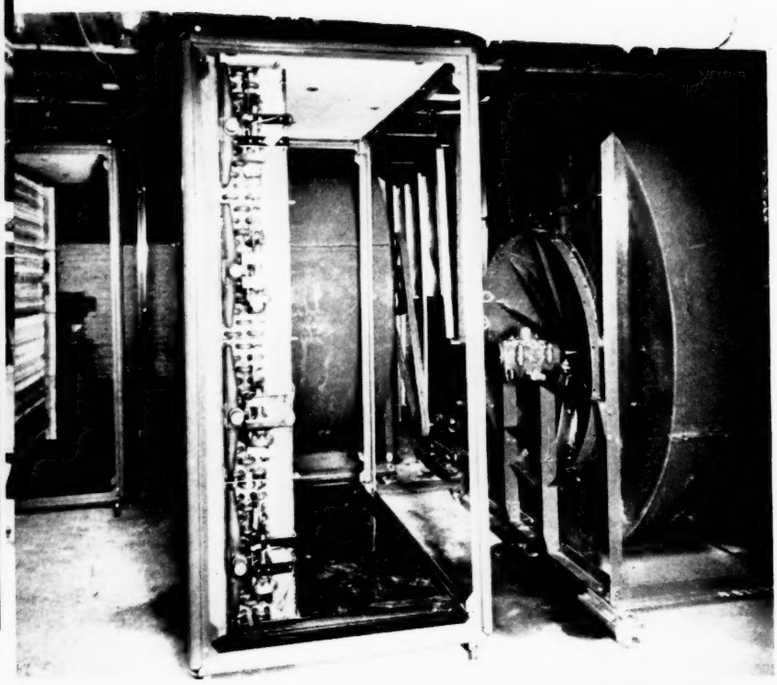
Cutting and Fitting

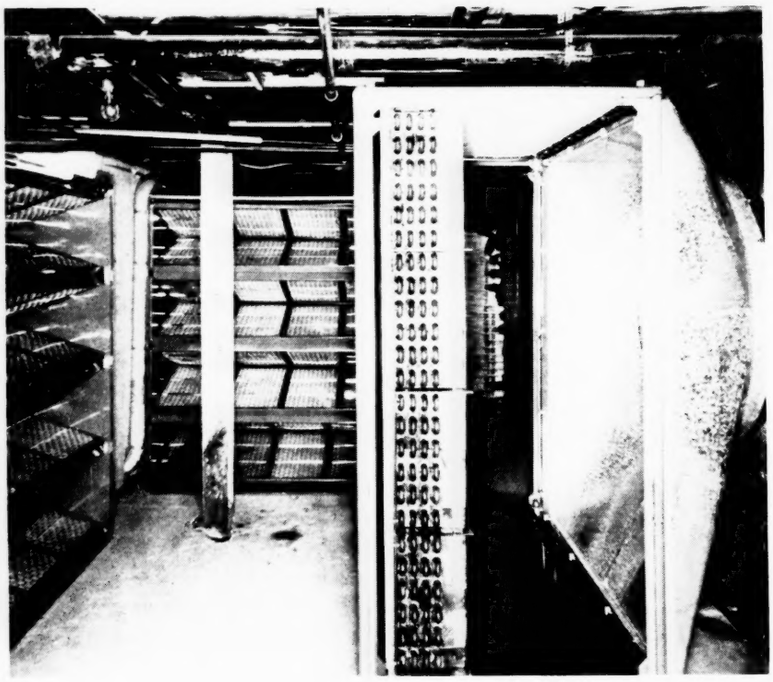
The cutting for the new duct work presented quite a problem; in fact it was impossible to make a contract price for this work. Before the equipment could be moved into the basement two partitions had to be re-

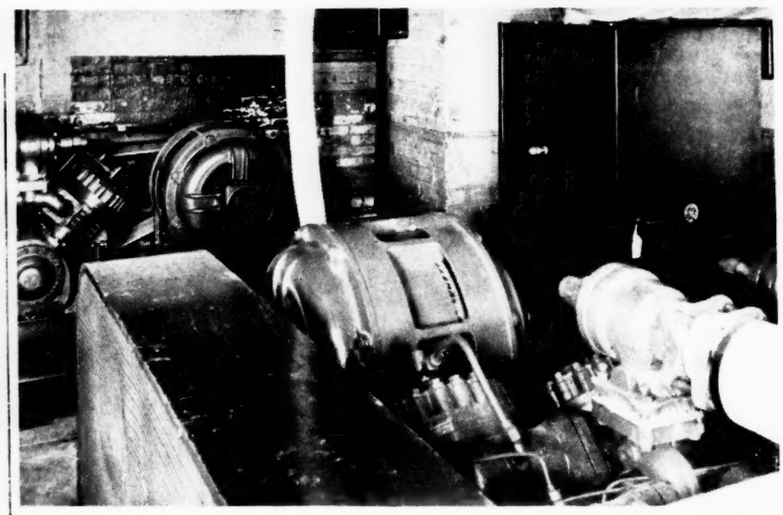
†Sales Manager, Contractor Sales Div., Air Conditioning and Commercial Refrigeration Dept., General Electric Co., Bloomfield, N. J.



First step in the installation of air conditioning equipment in Proctor's Theater was positioning of the two large centrifugal fans in the basement.







moved and 3 by 7 ft. opening made in another. The openings from the basement under the orchestra pit into the plenum chamber under the main floor also had to be cut before the equipment could be installed. This proved to be more of a task than was originally contemplated because the orchestra pit floor had been laid on the ground. Several yards of dirt had to be removed and three brick walls cut. Steel lintels were installed over all the openings, and retaining walls were built to keep the dirt from filling up the openings; steel I-beams were installed to support the concrete floor.

The other major cutting operation was a 40 in. circular hole in the center of the ornamental, hung ceiling. This opening was 87 ft. from the floor, and the material to be removed consisted of steel bars with plaster around them. Care was necessary in order to prevent damage to the seats from falling plaster. A circular scaffold, 12 ft. in diameter, with an 8-in. retaining rim of plywood, was constructed and hoisted into place against the ceiling. This was secured in place so the men could then work in safety; it also served to catch all the material cut from the opening. A second scaffold was built above the hung ceiling for a distance of about 40 ft. to act as a support for the duct work; this was suspended from the steel roof beams. The remaining openings in the ceiling under the balcony and mezzanine were comparatively simple to cut, and no particular difficulty was experienced.

After the cutting was well started, the sheet metal men started work on the new ducts. They set up the two blowers and connected the outlets together into one duct, which was then run under the orchestra pit into the plenum chamber. Here it split and a 40-in. square duct was connected to the bottom of the old gypsum block shaft. The top of the shaft was connected with another duct, which was installed on the scaffold above the ceiling and connected to an Anemostat. This duct handles 12,000 c.f.m. The other delivery duct, handling 18,000 c.f.m., was connected to the heating ducts under the first floor. In the plenum chamber under the mezzanine, round ducts were connected from the heating duct to four Anemostats in the ceiling. The risers were extended into the exhaust chamber under the balcony, and four additional round pipes installed to Anemostats in this ceiling. These outlets are now used for heating as well as cooling.

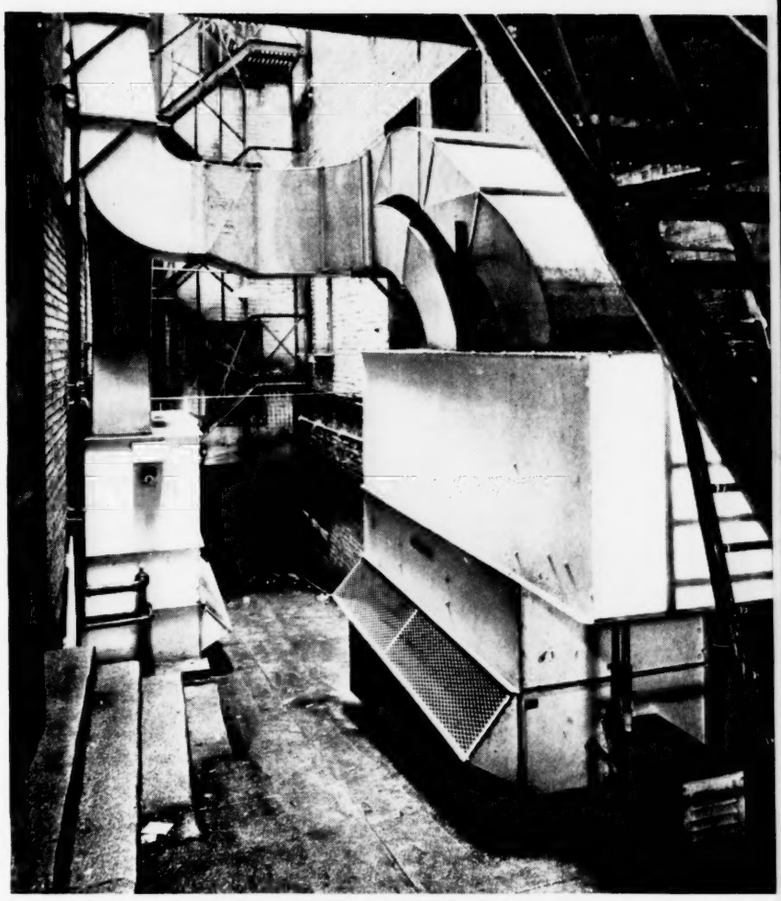
The return air duct is just a short connection to the plenum chamber under the main floor. Outside air is brought in from a court between the office building and the theater. Fifty per cent of the air supplied to the theater is outside air.

(Top). Second, the cooling coil sections were installed adjacent to the fans. Each of the two sections is made up of four direct expansion coils.

(Middle). Third step was the connection of shrouds between fans and cooling coil sections. Filter sections (left) are ready to be moved into place and bolted to coil sections.

(Left). Refrigeration for air conditioning Proctor's Theater is furnished by two 60 hp. compressors installed in these cramped quarters in the basement.

In a court between Proctor's Theater and an adjoining office building, two General Electric evaporative condensers were installed to conserve water used by the air conditioning systems. They will pay for themselves in a comparatively short time by reduced water costs.



Refrigeration Equipment

Two 60 hp. General Electric compressors and their starting controls were installed in a room adjacent to the court. Because of the water costs, evaporative condensers were used instead of water-cooled units. Figuring an average water consumption of 100 gallons per hour per compressor horse-power the water consumption would be about 12,000 gallons per hour if water-cooled condensing units were used on this job. Evaporative condensers dissipate the heat by blowing air over the condenser which is sprayed with water. This reduces the water consumption by 90%; therefore, about 10,800 gallons of water per hour are saved, less the power necessary to operate the blower. Hence the added cost of evaporative condensers was more than justified.

Evaporative condensers were installed in the same court as the outside air supply duct. Incidentally, it was necessary to install discharge ducts from both evaporative condensers up the side of the theater so that the heat could be expelled above the roof, to preclude the possibility of heat being taken back into the system by the fresh air connection.

Refrigeration tubing work between the various units was a simple job and incurred no difficulty. High temperature sweat fittings were used and a good, permanent job obtained.

More Economical Power Service

Electrical service for the switchboard was not adequate for the new system. Two meters were being used, one for three phase power, the other for lighting. By changing this service to a single, four-wire, 208 volt circuit and installing one meter, a considerable saving in the previous power bills was effected.

The control system is extremely simple. The blowers are manuallly operated, being started by magnetic, across-the-line starters. Each starter is equipped with an auxiliary switch, and the control circuit for all the other apparatus is taken through both of these switches. The entire system can, therefore, be started and stopped at this point.

Two duct thermostats in the return duct from the theater operate the balance of the equipment in response to a call for cooling. One thermostat is set two degrees lower than the other so that only one set of equipment will operate under average conditions. The second system operates only as, if, and when the load increases and the temperature rises higher than the setting on its thermostat. A time delay relay, set for thirty seconds, prevents the two compressors from starting at the same time. This, together with reduced voltage starters on the condensing units, prevents excessive starting currents which would cause a noticeable drop in voltage.

Costs

Use of evaporative condensers, the saving secured by having one electrical meter instead of two, and use of two independent systems with two thermostats, resulted in an over-all operating expense only slightly above previous operating costs without the air conditioning system.

This detailed description of the equipment and its installation is typical of the problems encountered in this type of work. The net capacity of the Proctor's Theater system is 110 tons of refrigeration, and it cost about $220 per ton. A few years ago when this theater was surveyed for air conditioning the price was about $350 per ton.

Rapid strides in the manufacturing and design of apparatus, increased production, and the design of systems by experienced engineers and contractors have decreased the cost of air conditioning to this extent. Most other businesses, incidentally, have been forced to increase their prices during the past few years.

With the cost of air conditioning as low as it is today, every theater owner and manager who has not done so should give this problem his serious consideration. At this time of the year, it may be apropos to point out that a system planned and installed during the winter months will cost less, as a rule, than one installed in a hurry during the spring and early summer.

Air Dilution in Industrial Ventilation

By W. C. L. HEMEON†

This is the third of a four-part series of articles by the author on the general subject of diluting contaminants in the air to reduce their concentration in industrial ventilating jobs. The concluding installment will appear in the March issue.

Local Exhaust vs. Dilution Ventilation

THE preponderant space devoted to the subject of dilution-ventilation in the preceding discussion should not be construed to mean that this method is more important than local exhaust. The latter is probably the more appropriate method in the majority of situations involving toxic substances.

When calculations indicate that unreasonably large quantities of air would be required by the dilution method, one must look to local exhaust ventilation for the solution, not overlooking the possibility of a dilution effect accompanying the local exhaust action which might materially affect the air quantity required.

Metallic Fumes, Dusts, etc.—Cases are uncommon where anything but local exhaust is adequate to the control of pneumoconiosis-producing dusts, lead fumes and lead dust, mercury, chlorinated naphthalenes and others in that group. The allowable concentrations for these substances are so low relative to the amounts commonly dispersed in industrial processes that air quantities required to dilute them adequately will often reach fantastic proportions.

Exceptions to the above are to be found. Dilution-ventilation is sometimes of value in situations of temporary, large scale contamination of the atmosphere as, for example, in foundries during dumping of castings and conditioning of sand, and this only if those processes are of relatively short duration (e.g. 1-2 hours) and if the volume of ventilation is generous. (A certain foundry has propeller fans with a total capacity of 220,000 c.f.m. which are operated only during a 2-3-hour period of pouring a dumping of castings. Conditions are thus markedly alleviated, although it is quite impractical to use the ventilation during cold winter weather.)

Another exception is illustrated by the following circumstances in two printing establishments:

1. In a room where 30 linotype machines were in use with electrically heated type metal pots, concentrations of 0.5 mg. per 10 cubic meters were found when the room was ventilated by propeller fans with a capacity of 25,000 c.f.m., or approximately 1000 c.f.m. per machine.

2. In a small room housing 14 monotype casting machines and with natural ventilation through windows, of undetermined extent, concentrations of lead less than 0.4 mg. per 10 cubic meters were found.

Thus, in these circumstances general ventilation is obviously practical but, as a general rule, industrial lead pots give off much greater quantities of lead fumes, necessitating the use of local exhaust ventilation.

Defining Dilution Ventilation—For the sake of systematizing thought and field test data, it is desirable to have a more clear cut definition of the two types of ventilation than was referred to at the start of this paper. The following is suggested.

When concentrations of a contaminant in an exhaust duct or in the air stream leaving a workroom through a fan are of the same order of magnitude as those in the room atmosphere, the action is one of dilution. On the other hand, in a true local exhaust system concentrations in the air stream inside the exhaust duct will be materially greater than those in the surrounding atmosphere beyond the zone of influence of the exhaust.

Where, however, both processes coexist in the same system, the extent to which the local exhaust action operates is represented by the ratio of the difference in concentrations to that in the effluent air stream.

$$\text{Proportion removed by local exhaust} = \frac{\text{Conc. (effluent)} - \text{Conc. (room)}^*}{\text{Conc. (effluent)}}$$

*Just beyond the zone of influence of exhaust inlet.

Use of this relation is illustrated in Example A (Table 4) in which it was shown that the ventilation action was 52% local exhaust.

Air Distribution

In systems of ventilation by dilution, the distribution of air currents in the room is of importance.

It is helpful in obtaining a clear mental picture of the important air currents in such a system to think of it as deriving its most important effects by *entrance* of fresh air into the working space under the influence of a negative pressure created by a fan.

Blowing vs. Exhausting—Consider the two situations illustrated in Fig. 4. "A" represents a room with a fan exhausting 1000 c.f.m. with an opening in an opposite wall through which air enters under the influence of the fan. If the room has no other openings for the entrance of air, then the effect is identical with that illustrated in "B," in which a fan *blows* 1000 c.f.m. into the room, the air escaping through an opening in the opposite wall.

Furthermore, if, as shown in "C," two fans are employed, one blowing 1000 c.f.m. into the room and the other exhausting 1000 c.f.m., the net effect is again the same as in the preceding two cases, except for the effect of a small reduction in static pressure in the room which would increase the capacity of the propeller type fans

†Engineer, Division of Occupational Hygiene, Massachusetts Dept. of Labor and Industries.

To the end of the last paragraph, first column, page 42, of the author's article in the November issue, should have been added the words "per 100 workers" so that the formula which followed it should have read

$$\frac{0.027 \times 1{,}000{,}000}{170} = 160 \text{ c.f.m.}$$

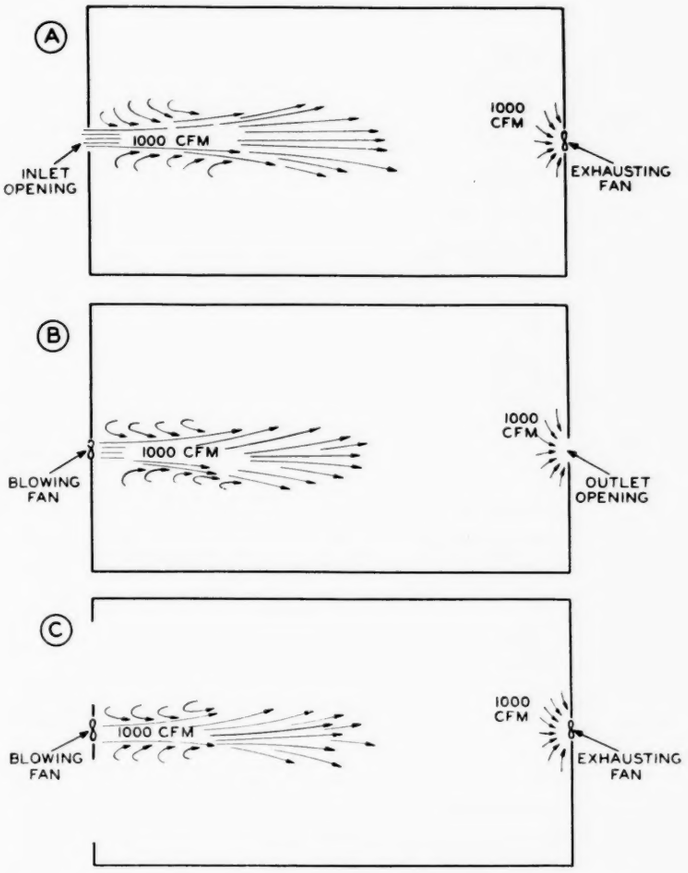


Fig. 4. Illustrating relative importance of air currents in blowing and exhausting systems. The situation respecting air currents is practically identical in cases A, B, C, although function of fan is different in each case. Rooms in A and B are air-tight except at entrance and exit.

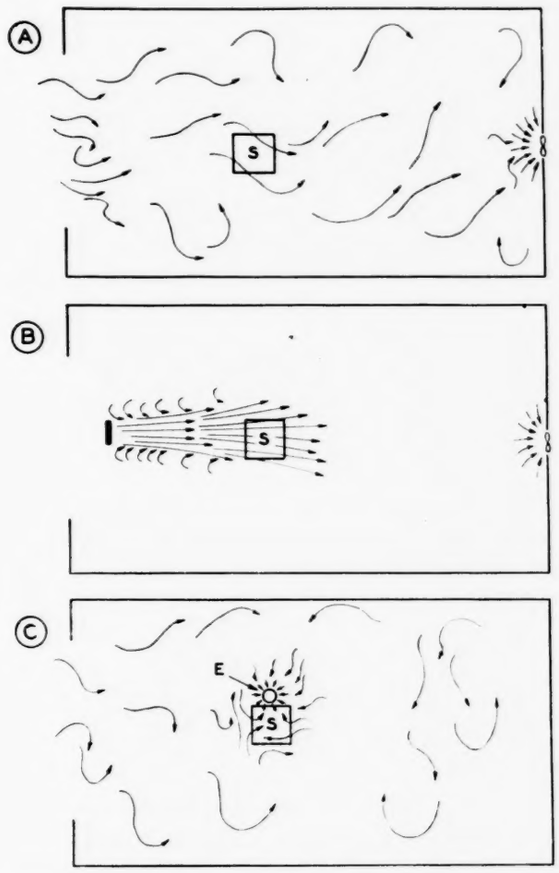


Fig. 5. Illustrating importance of fan location in a system of dilution ventilation. S represents source of vapor and location of worker. Arrangement A is inefficient, B is effective but dangerous to worker comfort, C, "localized dilution," is best. (E represents exhaust inlet).

slightly. The main fact to be noted is that the net air movement in the room is not the sum of each fan's capacity (2000 c.f.m.) but still 1000 c.f.m., approximately.

Air Currents—There are two significant groups of air currents in the cases discussed above. One group are those induced at the exit whether or not an exhaust fan operates in the exit orifice and the velocities induced around this point follow the law of local exhaust hoods previously referred to in which linear air velocities decrease with distance from the orifice according to the equation

$$Q = 0.75V(10\,x^2 + A),$$

the 0.75 factor being warranted by the fact that the orifice is flanged by the wall. Convection currents with velocities of from 25-50 f.p.m. are commonly found in occupied spaces, even in the absence of exhaust systems. With open windows such currents may run up to 200 f.p.m. or more. The distance from the fan at which velocities of this magnitude are generated for any given fan can be calculated and it is a relatively small distance. For example, a 30-inch fan with a capacity of 7250 c.f.m. would induce significant air velocities at a distance of 3 to 4 feet. Beyond this zone, air velocities are insignificant; that is, they are of the same magnitude as natural convection currents.

On the other hand, the air currents entering the room through the single entrance orifice, whether under the influence of a blowing fan or an exhausting fan in another wall, extend relatively great distances into the room and in, approximately, a straight line. The distance from the inlet to the point beyond which velocities are not significant (less than 50 f.p.m.) is dependent on the initial velocity and on the area of the opening. Greenlaw[7], on the basis of extensive experimental studies, has deduced some valuable data on this subject.

Air Entrainment—Such positive air streams entrain considerable quantities of air from the space adjacent to its path such that the average velocity of the stream is continually reduced with distance from the source. A further effect of such entrainment is to render it virtually impossible to realize pure air conditions in a fresh air stream that passes through a space containing contaminated air except at a very short distance from the entrance.

Thus, in the cases illustrated in Fig. 4, the significant air currents are (1) those induced at the outlet from the room in a zone extending out only a few feet in most cases and (2) those of the positive air stream entering the room which extend great distances into the room. Obviously, the currents of air *entering* the room are the important ones when no important source of contamination lies within the zone of influence of the outlet orifice.

[7]Greenlaw, A. L. and Hart, T. S. "Air Paths From Grilles," *Heating, Piping & Air Conditioning*, June, 1938.

In the common situation where, unlike the conditions illustrated in Fig. 4, a workroom has numerous openings large in total area, permitting flow of air from adjacent spaces at low velocities, the effect of entering air currents just described may be lessened or entirely eliminated. If, in the same case, no sources of contamination are located within the zone of influence of the exhausting fan, then the nature of air currents is unpredictable. Processes within the room may, of course, generate significant air currents.

Localized Dilution—We have also to consider the important situation where, as in the case just described, there are no significant currents of air at entrance or at the exit, and the source of contamination covers only a small area relative to the cross-sectional area of the room. (See "A," Fig. 5.) Random air currents having low velocities of convectional magnitude yet having a net positive velocity in the direction of the fan will mix with the air-borne contaminant, but under the cited conditions it will be a sluggish process and steep concentration gradients may be expected from the source to more distant portions of the room. Workers stationed in close proximity to the source would be exposed to materially higher concentrations than the true average for the room as a whole. In such a case, generation of air currents in the concentrated area as indicated in "B" (Fig. 5) by means of any of the arrangements of Fig. 4 will maintain the atmosphere in a state of agitation and aid in the dilution process, but the risk of causing discomfort to workers subjected to high air velocities is great. A better method is to locate the air outlet in the vicinity of the contaminating source, thus requiring all air for dilution to travel through that zone ("C," Fig. 5). It is to be emphasized that this would still be a dilution process unless at least some of the source of contaminant were located within the zone of influence of the exhaust inlet proper. This arrangement is illustrated by the peripheral exhaust slots on a degreasing tank located in a large room which, if it is not entirely a dilution mechanism, is so, at least, in large measure. Lacking any better term such a system will be called *localized dilution.*

Objectionable Drafts—The importance of the foregoing facts relating to entering air currents is illustrated by the case of wood-heel covering ventilation, discussed earlier in this paper. The danger of drafts is real because such rooms are usually completely enclosed for fire-proofing, and extra space within the room may be limited. Hence, the open doorway through which all supply air enters the room under the influence of the exhaust system is in close proximity to some of the workers and if air velocities exceed certain values discomfort may result. Maximum permissible velocities for inlets to occupied spaces are commonly taken as follows:

120 f.p.m. for inlets less than 8 ft. above floor
250 f.p.m. for inlets less than 8-12 ft. above floor
500 f.p.m. for inlets less than 12-18 ft. above floor
1000 f.p.m. for inlets greater than 18 ft. above floor

These are subject to the condition that the temperature of the entering air be not more than 10F cooler than that of the room air.

The remedy in the wood-heel covering situation is in providing (1) doorway openings totalling at least one square foot per worker or (2) openings more than 8 feet above the floor totalling more than one-half square foot per worker. These are based on a ventilation requirement of 80-100 c.f.m. per worker.

Clean Air Ups Skating and Dancing Attendance Forty Percent

Extensive building renovation, including the installation of a 15,000 c.f.m. Westinghouse Precipitron electrostatic air cleaner, has resulted in an average attendance increase of 40% for Hamilton, Ontario's Alexandra Skating Rink. Cleaning costs have been considerably reduced because less frequent cleaning is needed; tobacco smoke, and skating powder dust have been entirely removed from the interior atmosphere.

Before modernization, skating and dancing hall was troubled by bad dust conditions in the air. On dance nights, it was almost impossible to see from one end of the 150 ft. long building to the other due to the blue tobacco smoke haze. The condition was even worse on skating nights, because the fine chalky powder which is placed on the floor to prevent side-slipping of the skates, was agitated by the fast moving skaters, and whirled around in the air. This, in combination with the tobacco smoke, made seeing and breathing rather difficult.

20 Precipitron cells, having a 15,000 c.f.m. total cleaning capacity, were installed to take care of the 150,000 cubic foot hall. Cells are in a single bank located in a penthouse just outside the main hall and ducts carry the clean air from there into the ceiling space, where it enters the hall through ceiling grilles. Return grilles are also located in the ceiling. All duct work is concealed. Although for the most part, recirculated air is employed, fresh outside air may be injected into the system when required. One fan, driven by a 5 hp. motor, circulates the cleaned air.

Results have been spectacular. Blue tobacco-smoke haze is entirely eliminated, and on skating nights not only is still true, but the chalky skating-powder dust is no more in evidence in the atmosphere. More important than these direct accomplishments are the benefits they make possible. With elimination of the chalky dust, frequency of cleaning is far less now than before. In such a large building, this represents quite a saving.

Greatest benefit has been increased attendance. On Saturday dance nights, attendance has risen from 700 or 800 to 1000 or 1200. On week skating nights, including the Wednesday dance night, attendance has risen from about 500, to 700 or 800 people. Though this attendance increase is due in some part to the general re-decoration of the hall, the clear freshness of the interior atmosphere has played a major part. Added revenue is expected to exceed the approximate $5600 cost of the Precipitron very shortly.

Managing Anthracite Stoker Servicing

By RALPH A. KRAUSS†

The author here discusses the management functions in properly operating a service department for anthracite stokers. This article is preliminary to and will be followed by one dealing with various types of service problems and how they can be solved.

THE service department, for more reasons than one, can make or break a stoker dealer. Service constitutes the final contact between the dealer and the customer, often under dramatic conditions, and therefore exerts a great influence upon the dealer's reputation. On the other hand, it is a necessary expense of the business and, if not kept at a reasonable figure by good management, can sometimes eat up the profits.

Low service costs are mainly a question of intelligent planning and common sense. Scheduled service calls for preventive maintenance are cheaper than emergency ones, as they may be made according to a convenient itinerary. Furthermore, a routine call, by uncovering a source of trouble before it develops, can often forestall expensive repairs and customer discomfort. Naturally there is a limit to the profitable number of such inspections.

The experience of most dealers has been that the majority of service calls occur during the first month of operation. This leads to the conclusion that breakdowns due to faulty design or manufacture are relatively few, and that poor installation or adjustment, or unfamiliarity of the owner with the reasonable limitations of the equipment are the most prevalent cause.

Routine Inspections. Two scheduled inspections are usually sufficient. The first should be made between 24 and 48 hours after the installations is first put into service, and the second a week or two later. However, should it ever be necessary to make extensive repairs or adjustments, similar subsequent inspection may be advisable.

The inspector should be a man of wide experience and greater technical knowledge than the installer, for one of his duties is to discover possible faults or omissions in the installation, and to recommend the proper corrective measures. He should also observe the appearance of the fire and of the ash and make a flue gas analysis, so that the preliminary setting of the air may be adjusted if required. The temperature of the stack gases will show whether the boiler has adequate heating surface or is properly baffled, and draft measurements will show whether it is practical to install baffles.

Noise, vibration, odors, gases, operation of the controls, and the general reaction of the owner should also be noted.

The best time to make these routine inspections is either early in the morning or late in the afternoon. Less heat is needed during the day and the stoker operates only at intervals. Proper observation of the fire requires that the stoker be running for perhaps a half hour. Sometimes, however, permission may be obtained to open windows so as to cool off the house and allow the machine to run for the necessary interval.

In brief, the value of the inspection depends upon the ability of the inspector to detect possible causes of future trouble and to exercise good judgment of the observed conditions.

Handling Service Calls

Each installation should be equipped with a cellar card tacked to the coal bin or hung near the stoker. This card should contain simple concise instructions for the owner, to be followed in case of trouble. Here is a suggested form:—

> IN CASE OF TROUBLE, quicker and more effective service can be rendered if you will cooperate as follows:—
>
> See that there is coal over the end of the feed screw in the hopper or bin.
>
> If you have a steam boiler, see that there is water in the glass.
>
> Is the motor running? Steadily or intermittently?
>
> Is there a fire in the firepot? Dead ashes? Unburned coal?
>
> Phone 5-8988 during the day; 3-5443 at night, Sundays, or holidays.

The size of the organization will naturally determine whether a service man will be kept on duty at the shop at all times, or whether night calls will be taken by the service foreman at his home.

Card File. Emergency service will be rendered more efficient by the use of a card file containing all pertinent information on each installation. This file should be kept at the telephone in the service department, and if the service foreman takes night calls at his home, he should have the same information available in some form.

Because the name of the owner or tenant may change without the dealer being informed, the cards should be filed according to the street address. However, the name of the occupant of the premises should also appear as a check.

The following information should appear:

- Type and size of stoker.
- Size, rotation, and electrical characteristics of motor.
- Type of heating system.
- Estimated heat loss.
- Connected load.

†Combustion Engineer, Anthracite Industries Laboratory, Primos, Delaware.

Coal feed.
Size of coal.
Record of adjustments.
Record of service.
Instructions for finding premises at night; information about dogs, servants and cellar entrances.
Unusual features of installation.

With this data at hand, the serviceman can ask but a few pertinent questions over the phone, and start out fully prepared with the proper repair parts and tools.

Reports. The serviceman should submit a written report of each call, describing the conditions as found and the remedies applied, together with recommendations for future avoidance of the same trouble, and if temporary repairs were made, permanent correction should be specified.

These reports are reviewed by the service foreman who may then decide whether a subsequent inspection is in order. The information is then transferred to the service card to complete the record.

For the customer's edification, each service call (except for routine inspections) should be followed by a letter stating what caused the trouble, how it was remedied, and what he may expect in the future. Such letters have inestimable value in building goodwill, and they should be written or at least reviewed by someone more skilled in public relations than is usually expected of the service foreman. In large organizations this may be the advertising manager; in small companies it may be the managing head of the business.

Appearance and Deportment. All customer contacts call for politeness and tact, and in stoker service this begins with the telephone complaint. Emergency calls in particular find the owner at least slightly perturbed. He must first be reassured, and then questioned, adroitly and courteously. Not only the specific complaint, but the answers to the questions on the cellar card must be ascertained. By this means the serviceman may not only anticipate the problem, but may often even obviate the necessity for making a trip, as for example if the trouble is due to tampering with the controls or a shortage of fuel. At any rate, he will be better informed as to what is required in the matter of tools, repair parts, and time.

It is a common practice for the serviceman to enter by the cellar door, without announcing his arrival, and go to work immediately. Often this results in a complete correction of the trouble and a restoration of service before the customer knows he has arrived. Meanwhile the worried customer may be pacing the floor upstairs and consulting his watch at two-minute intervals.

As an alternative, it is recommended that the serviceman present himself, clean and neatly dressed, at the front door, announce himself courteously, and ask to inspect the thermostat. This should be done regardless of information obtained over the telephone, but the customer should be flattered by having his conclusions confirmed, if possible.

This accomplished, the basement should be entered and overalls donned. Trips to the car for repair parts and tools should be made through the cellar door or the kitchen. The job finished, overalls should be removed, hands and face washed, and the customer advised that service has been restored, with the assurance that all will be well, and that possibly a routine check-up will follow.

Diagnosis of Complaints. In locating the source of trouble, the serviceman has the alternative of using his own brain or a service chart. The latter may be the work of an undoubted expert, but at best is vicarious and somewhat limited to generalities. Any man worth sending on a service call is in a better position to size up the situation than one who not only has never seen the installation, but must also figure out the answers to hypothetical difficulties. Stated in other terms, it is better to send an intelligent man to the job than for a master-mind to figure out all the answers in advance and send out a man who can't figure it out for himself if the answer isn't in the book.

To this rule there is a minor exception. Stokers differ in many small details of their construction. The manufacturers, therefore, have found it necessary to furnish instructions for servicing their specific machines, and this may sometimes be condensed into the form of a chart for quick reference. However, after a short while the serviceman should become sufficiently familiar with the design to dispense with the book except possibly upon the occasion of circumstances which have not previously arisen.

Obviously, we must here confine ourselves to a discussion of stokers in general rather than particular makes or types which have already been adequately described by their manufacturers in service manuals.

Diagnosis of stoker complaints is a process of applying a few simple tests to an understanding of the functions of the various parts of the heating system. Before discussing specific faults and their remedies, however, let us clarify the situation by classifying the various types of complaints.

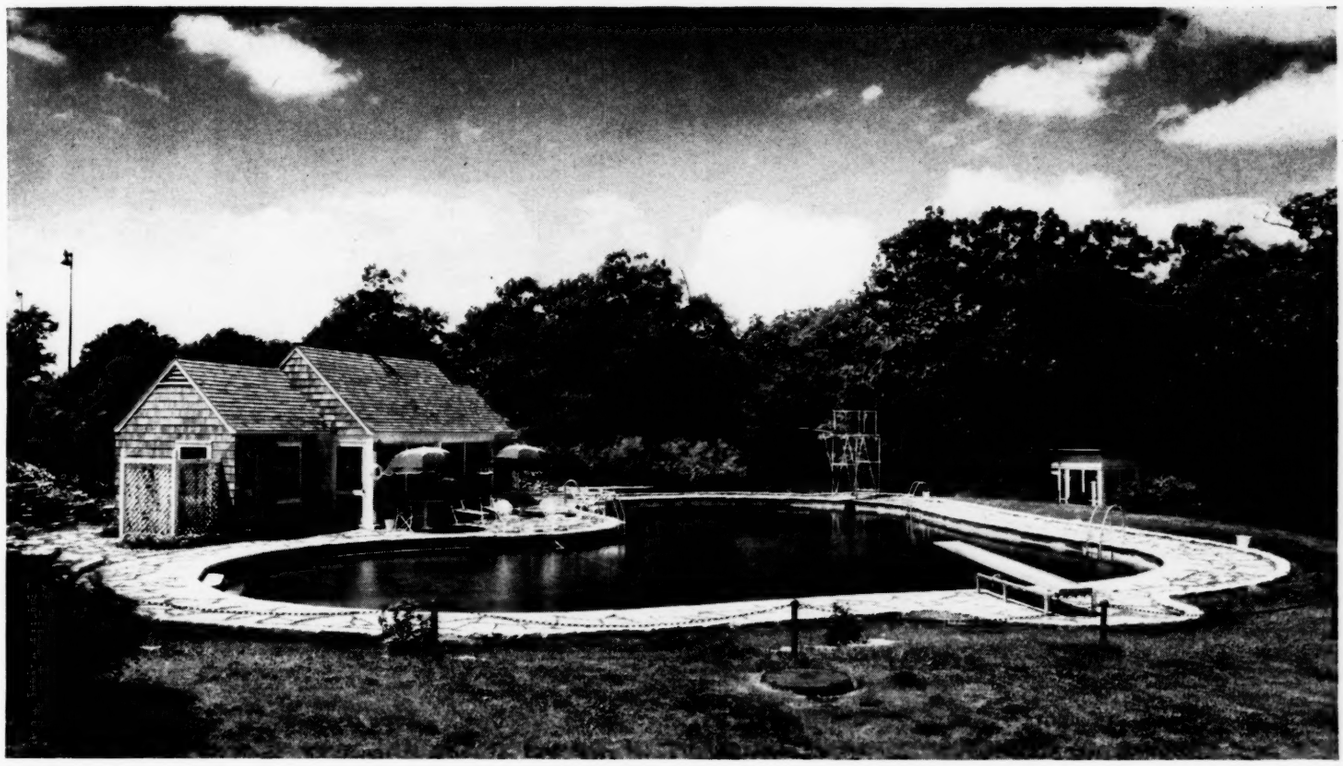
Types of Service Complaints

As a service call may be occasioned by a combination of causes, it will be well to classify by symptoms:

1. Emergency due to insufficient or total absence of heat.
2. Poor efficiency (real or imaginary), of which the symptoms may be improper appearance of fire, excessive combustible in the ash, or excessive coal consumption.
3. Unsatisfactory control, including under- or overheating at times and uneven temperature distribution.
4. Nuisances, including noise or vibration, dust, and odors or gases.

It must be remembered that, although the stoker dealer may be called upon to rectify any of these troubles, the fault may often lie outside the province of the stoker. For this reason the serviceman requires some knowledge of the fundamentals of heating systems, so that he may not only locate the source of the difficulty, but make the proper adjustments, emergency repairs, or recommendations.

(In next month's article, Mr. Krauss discusses the above classified complaints in detail.)



Water from air cooling coils waste into this swimming pool, supplying it with fresh water. The pool overflows into creek below.

Well Water Cooling for an Unusual Residence

By W. A. MURDOCH

A residence with an average population of twenty-five is by no means common and the consequent problem of air conditioning such a building, especially when the house has a roof area of over 3700 square feet, presents some complications. How this building was air conditioned with well water is explained by the author.

AN unusual job of well-water cooling, that in a residence near Chicago, has been designed by Roy M. Moffitt and Company of Chicago. In this case the entire cooling load—some 11½ tons—is carried by well water. Because of a number of circumstances, however, this job presented complications which were more of an industrial and commercial nature than those usually found in a residence.

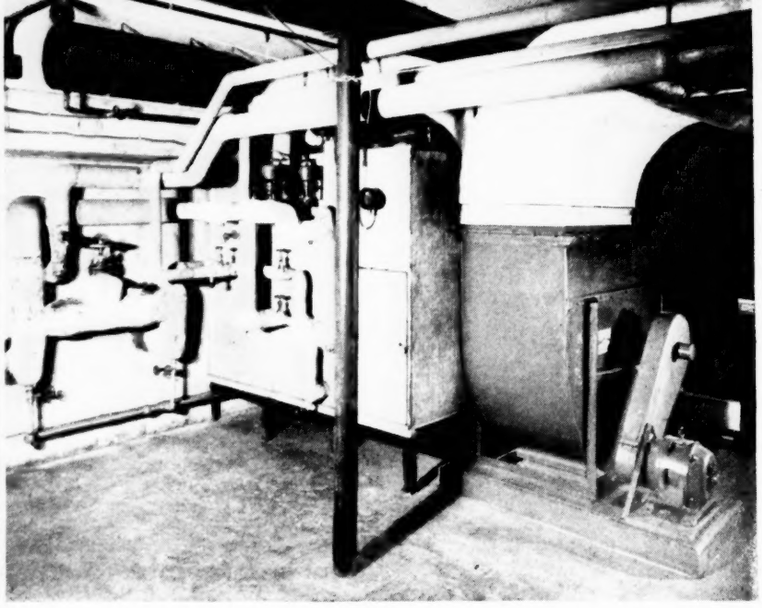
The house is located some distance from Chicago in the Des Plaines River valley in the midst of heavily wooded grounds, so that even the light summer breezes are cut off and offer little or no help in offsetting the direct rays of the sun. The building is a one story structure, U-shaped and sprawling and with 3,718 square feet of roof, about equivalent to a building 61 feet square. Furthermore, while the roof is somewhat A-shaped, the interior finishing is such that an attic is practically non-existent, with little or no air space. A further idea of the exposure may be gained from the fact that the heating plant was sized on the calculated basis of 1,490 feet of equivalent steam radiation.

Another unusual circumstance which had to be considered was the uncommonly large and varying population. The owner is a host on a fabulous scale; as many as fifty people have been served full course dinners at an immense table set in the high-ceilinged living room. The presence of twenty-five guests at one time is common, and at ordinary social functions, such as bridge parties and dances, thirty guests are considered a minimum. Thus, the matter of body heat and traffic in and out doors was an important factor. From a cooling standpoint, the job resembled a restaurant or club.

Fortunately the residence is located in a limestone area in which there is an ample supply of water at a thousand feet depth. More than that, the water never rises above a 54F temperature at the surface. With all these factors in mind and basing calculations on a population of forty people, the engineers worked out a system which has proven satisfactory over a period of four summers—one of them a season of notable extremes.

Cooling System

The cooling unit consists of continuous finned coils set six rows deep within a chamber. A manually-controlled blower forces the air over these. The well



Well water cooling equipment which consists of continuous fin coils set 6 in. deep and mechanically controlled blower and thermostatically controlled water valves which regulate the flow of water in accordance with the temperature of air in the return duct.

water is first pumped into a pressure tank through an automatic, electric, deep-well water system. The flow of water through the cooling coils is regulated by thermostatically-controlled valves which operate on the rise or fall, above or below a pre-determined temperature, of the air in the return duct. A rise in the air temperature opens the valves and the cold water under pressure passes in greater or lesser volume through the cooling coils. When the temperature, fixed by a manually-operated room thermostat above is reached, the valves close. The water wastes into a swimming pool nearby the house and the owner thus realizes an economy in this by-product of cooling, for a freshening supply of water for the pool is thus made available at no cost.

Heating

During the winter, the pump is cut off and the coils are supplied with hot water from the heating system, fed by a circulating pump. The thermostatically-controlled valves then operate in reverse, activated by rise or fall of temperatures of the air within the return duct.

Over the four-year period during which the system has been in operation the water consumption has averaged 14 gallons per minute. Water entering the coils at a maximum temperature of 54F maintains a room temperature of 72F even during a heat wave during which outdoor thermometers registered 102F. While a heavy population increase brings room-temperatures above 72F, the maximum has always remained within the seventies and largely below seventy-five.

Design of System

In designing air conditioning systems where well water carries part or all of the cooling load, the Moffitt company has found by experience that a good rule to follow is *dig your well first.*

A water-well, like an oil-well, has a lot of unpredictable qualities about it. Consequently, the Moffitt company has found it wisest to establish as many known factors as possible before even beginning to design the system.

To begin with, there is no guarantee in advance that an ample flow of water at sufficiently low temperature will result from drilling at a given spot. Even a flourishing well a few hundred feet away assures nothing about an adjacent well, and dry holes have resulted in areas which by all surface signs should have been gushers. Sometimes, a promising well dries up or, due to caving or clogging with silt, its flow may fall so low as to be useless. Too, sulphur or other elements injurious to cooling coils may preclude the use of some wells.* Since the cost of sinking a deep well costs about one dollar per foot and as it may have to be sunk below a thousand feet, the rule dig your well first is excellent insurance against the failure of a well-water cooling system.

If possible the average flow of a well should be determined over a period of time, although this obviously has the elements of a gamble to it, and may signify little more than a maximum. The temperature at the surface, however, should be fairly well established. Water above 60F is not a satisfactory cooling medium for it leaves no safe margin. The best time of year to determine an approximate minimum is during September, or at least in the fall, a time when the earth's surface has been heated to its highest point. This is not, however, invariably the case, for the composition of some sub-soil may be such that it conducts heat slowly and well water temperatures may remain below 60F during July and August.

Control

One of the difficulties of a well-water cooling system is close, accurate control. Since regulating the flow of the cool water through the cooling coils is the only available method to control air temperatures, there must be a nicely sensitive valving action. After several experiments, it was found that this is best achieved through installing the smallest valves possible in keeping with the volume of cooling water required. For example, in this residential job, the supply pipe from the pressure tank is 2 in. This was reduced to ¾-in. valves. Naturally, an eighth inch movement in a ¾-in. gate valve gives much finer control than the corresponding movement of a 2-in. valve. This has made for close control.

Another necessity for a trouble-free system of this type is some method for venting the cooling coils. Air tends to gather in them and unless an escape is provided will seriously affect operating efficiency. The practice is to vent the accumulated air through a ¼-in. pipe into a tank above which in turn is manually vented at intervals. Maintenance, incidentally, has been practically non-existent. Strainers protect the control valves, and these have to be cleaned regularly, but other than this, operation has been completely trouble-free.

*The installation described in the foregoing is located in an extremely hard water area. Nevertheless, no trouble was experienced with depositing calcium, magnesium, etc.

Oil Used as Heating Medium in Forced Circulation System

A DUAL discussion on hot water heating by Arthur Hess of English & Laueer, Inc., Los Angeles, and Glenn Miller, heating engineer of the Southern California Gas Co., featured a recent Los Angeles meeting. Some interesting points, including an unusual mathematical analysis on hot water by Mr. Miller, and those on forced hot water in large installations by Mr. Hess, were raised.

Mr. Hess asserted that the use of hot water circulating systems has not progressed as had been expected in Southern California for two reasons: First, because there have not been very many large jobs in the last three years requiring any heating until quite recently; and, second, because of the usual resistance to any change. He qualified the latter statement by saying that most heating men today still believe the old fallacies about hot water heating, namely: That it requires large pipe sizes and large radiators, that it is slow heating up and cooling down, and that the installation is difficult and tricky.

"Recent developments in industry have changed this picture somewhat," Mr. Hess said, "and we now have installations (in Southern California) which prove the contentions of the proponents of hot water heating that this form of heating is one of the major forms. We are just beginning to realize that Southern California has developed into a great industrial center, with many plants making a triple use of floor space and facilities by operating 24 hours a day. This means that we can no longer build factories in Southern California without heating facilities, for even though the day temperatures can get by without heating, the night temperatures cannot do so."

Direct gasfired unit heaters, first used when plant engineers found the cost of steam heating systems too high, Mr. Hess declared, were found unsatisfactory for large factories principally because of high maintenance costs and the objections of insurance companies to the large number of scattered open gas flames through the plants.

He declared that modern hot water design has offered a central plant system which can be installed at nearly the same cost as a gas-fired unit heater system and that many new industrial plants in Southern California regard hot water heating systems as the answer to their long-existing heating problem.

In conclusion Mr. Hess briefly described a hot water heating system recently installed in the new Naval Reserve Armory at Los Angeles.

"I was surprised," he said, "at the calls received telling that the system could not work because the boiler was hooked up backwards, which meant the return water was brought into the top of the boiler and the supply was taken out at the bottom, which must be admitted is upside down for steam, but is not so for water, a perfect example of how unconventional the design of this type of heating can be."

Mr. Miller stated that about three years ago it became evident to some of the gas company personnel in Southern California that the types of heating system which dominated the California market at that time —unvented space heaters, gravity and forced air heating — did not fill the demand for heating systems completely.

"It seemed at that time," said Mr. Miller, "that there were certain functional advantages to be obtained with some variation of the forced circulation hot water heating system. Individual room control is easily obtained with such a system. This method of heating is absolutely safe and the possibilities of combining such a system with an added cooling system are very great if the use of fan operated convectors be made a part of the installation."

He declared that his company had made an exhaustive study of the possibility of installing—at a price competitive to forced air heating — a heating system capable of individual room control, rapid pick-up, and capable of serving as a base for a cooling system to be added later. The study was made, according to Mr. Miller, in an effort to find a way to install a heating system free from all the objections to unvented space heaters, gravity furnace and forced circulation warm air heating and which would avoid the valid objections to existing hot water heating jobs.

"The first inquiry was directed toward the reduction of first costs," said Mr. Miller. "It seemed obvious that the circulation of a smaller quantity of fluid with greater temperature drop through the convectors with a higher friction loss per unit length of pipe, would substantially reduce the cost of piping. Also, since it can be demonstrated that for pipes under about .7 inch outside diameter that the addition of insulation will increase the hourly rate of heat loss, that there would be some saving in insulation costs. Because of the fact that the heat emission from a finned convector is proportional to some power of the mean effective temperature differential greater than unity, it seemed advisable to consider the possibilities of greatly increasing the mean effective temperature. As the boiler represents a large part of the cost of the installation of a hot water heating job, the possibility of substituting inexpensive hot water heaters was considered."

Mr. Miller declared that in order to arrive at the mathematical limits for the increase in temperature of the circulating fluid as this temperature increase affected the annual operating costs of the system, the following analysis was made by Southern California Gas Co. heating engineers:

"The problem is to ascertain, considering all factors, first cost and operating cost, whether there is a tem-

perature which should not be exceeded for optional results. Four factors must be considered:

1. First cost of heater and pump. Let these costs equal C and assume them to be constant over any given variation in temperature.

2. First cost of radiation. Assume radiation required to vary as $1/(T - 70)$, where T equals average temperature of circulating fluid. This relationship is nearer $1/T^{1.3}$, but the first assumption will suffice.

$$\text{Then Cost} = D = 100/(T - 70)\ D_{175}$$

3. Copper piping costs. These costs can be assumed to vary as $1/(T - 70)$ also.

$$\text{The Cost} = E = 100/(T - 70)\ E_{175}$$

4. Operating costs. Since power for the pump can be assumed constant, these costs can be assumed to vary with $1/2500 - T$ and

$$\text{Operating Costs} = F = 2325/2500 - T \times F_{175}$$

where the subscripts refer to known values for a circulating fluid, leaving the boiler at 180F and returning at 170F.

The annual operating cost can be denoted by A.C., and:

$$\text{A.C.} = .15C + .15D + .15E + F$$

if 15% be considered the proper capital charge or

$$\text{A.C.} = .10C + .10D + .10E + F$$

for a longer amortization. If now

$$C = \$500$$
$$D_{175} = \$406$$
$$E_{175} = \$220$$
$$F_{175} = \$139$$

All of which costs apply to a particular layout and are considered as being approximately representative, in that they are in the proper relationship to one another, then, on a basis of a long amortization

$$\text{A.C.} = 50 + 4060/(T - 70) + 2200/(T - 70) + 2325/2500 - T \times 139 = 50 + 6260/T - 70 + 32.318/2500 - T$$

Differentiate with respect to T and equate to zero

$$d(\text{A.C.})\ dT = -6260/(T - 70)^2 + 32.318/(2500 - T)^2 = 0$$
$$(2500 - T)^2 = 5.2(T - 70)^2$$
$$6.250.000 - 5000T + T^2 = 5.2(T^2 - 140T + 4900)$$

Clearing and simplifying

$$4.2T^2 + 5172T = 6,225,000$$
$$T^2 + 1231T = 1,482,000$$

Complete the square

$$T^2 + 1231T + (615)^2 = 1,482,000 + (615)^2$$
$$(T + 615)^2 = 1,860,000$$
$$T = 749\text{F}.$$

"Consequently," Mr. Miller declared, "it immediately becomes apparent that on any job which bears a normal relationship between C, D, E, and F, the increase in operating cost with an increase in circulating fluid will not offset the decreases in first cost until an average temperature of the circulating fluid of 749F be reached, an impossible condition with present fluids."

Mr. Miller then described a heating system which was designed in accordance with the factors outlined above in one of the district distributing offices of the Southern California Gas Co. The circulating fluid chosen, he explained, was a petroleum oil having a flash point in excess of 350F, a boiling point at atmospheric pressure in excess of 500F, and an unknown viscosity. The system, according to Mr. Miller, was designed for a circulating fluid temperature of 325F. A positive displacement pump was decided upon and the piping was sized on the basis of a unit friction drop of about 1000 mil-inches per lineal foot with a fluid temperature drop through the convectors of about 50F.

Upon putting the system into operation, certain major difficulties were encountered, Mr. Miller admitted. It was impossible, he explained, to properly handle the circulation of the petroleum oil due to the tremendous viscosity encountered as the circulating fluid temperature approached room temperature.

"When the system was operated manually," said Mr. Miller, "and circulation through the convectors was carefully established by throttling the fire and bypassing the pump until the temperature of the entire body of the fluid was over 275F, very satisfactory heating was accomplished. The chief sources of trouble seem to be in the flow characteristics of the fluid and in the type of pump employed.

"A decision was reached to change the fluid to one having a more desirable viscosity characteristic, to change the pump from a positive displacement pump to a centrifugal pump and to incorporate true zone control on any future installations. As a result of these changes, the system was drained and cleaned out and a solution of 50% ethylene glycol and 50% water was placed in the system. A pump was used to circulate the ethylene glycol water mixture. This solution did not permit the use of such high temperatures as 325F, consequently, the high temperature setting was made at about 240F, and very satisfactory results have been obtained with this system for two heating systems."

New York's Largest Skating Rink Heated with Gas

Greater New York City's largest roller skating rink —the Rollerdrome, now under construction at 200 Empire Boulevard—will be one of the largest commercial heating jobs employing manufactured gas anywhere in the country. The Rollerdrome will have 30,000 square feet of inside floor area and will accommodate up to 3,000 skaters at one time. The gas load is estimated at 4,150,000 cubic feet annually.

Three factors entered into the Rollerdrome management's decision to use gas for heating. First, the initial cost for gas equipment was lower than for equipment designed for other fuels. Second, it was felt that there will be greater flexibility of control over temperature. Third, the use of gas equipment removed the need for a separate boiler room.

Incidentally, some idea of the size of the structure can be gained from the builder's estimate as to the amount of Michigan hard maple flooring which will be required. He computed that if the needed floor boards were placed end to end, they would make a strip 58 miles in length, or more than halfway from Brooklyn to Philadelphia.

Equipment to be used consists of seven No. 200 Humphrey unit heaters and five No. 100 Janitrol heaters.

ABSTRACTS of Current Papers, Books and Pamphlets

Modern Air Conditioning

All too infrequently do experienced engineers take the trouble and time to put the results of their experience in a permanent form. This is unfortunate as the progress of any branch of engineering is dependent, not so much on the amount of research work done or on the experience of a limited group of men, but on how rapidly and effectively this material is made available to students and persons practicing in the field.

The authors, Dr. Willis H. Carrier, Realto E. Cherne, and Walter A. Grant and the Carrier Corporation are to be congratulated on this book for it is one of the few textbooks on air conditioning which has been written by experienced engineers and which incorporates material not generally available.

While the entire book is well done, the sections on estimating requirements, economics, design of air duct systems, and noise elimination are particularly worthy of mention.

In previous books on air conditioning, the important subject of air conditioning economics is hardly mentioned—in this book there is a whole section devoted to it. In this section the authors point out a fact often overlooked by many engineers, that is, that intelligent design should regard air conditioning equipment as a long time investment and should accurately evaluate the total annual capital and operating charges and the contribution the equipment may make towards annual income rather than merely consider the first cost. There is much new material included in this chapter which will help the engineer to determine the original cost, depreciation, fixed charges, operating costs, maintenance costs, and most economical investment. A number of practical examples are included to show how the data are used. Many engineers will find that this chapter alone is worth the price of the whole book.

In the section on the design of air duct systems there is what is probably the best discussion on air duct design which has appeared to date. Included are numerous tables and charts which should simplify considerably the problem of air duct design. Extremely interesting are the figures showing air flow through fan discharge connections and supply duct take-offs. These illustrations explain the action of air flow far better than words could.

Other chapters which are particularly well done include those on fans, air cleaning devices, cooling and dehumidification, refrigeration, and air distribution. On the whole, the chapters on heating are not quite up to the generally high level of the rest of the book. However, it may be said that this subject is treated about as well as it is in the usual textbooks.

Taking the book as a whole it can be highly recommended to both students and practicing engineers. The large amount of material incorporated in the book has been particularly well organized and is presented in a very practical manner. It can be said, without fear of contradiction, that this book is the best textbook on heating, ventilating, and air conditioning which has appeared to date.

[*"Modern Air Conditioning, Heating and Ventilating," by Willis H. Carrier, Realto E. Cherne, and Walter A. Grant. Published by the Pitman Publishing Corporation, 2 West 45th Street, New York, N. Y. Cloth bound; 6 x 9 in.; 547 pages. Price, $4.50.*]

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Humidities in Residences

While it is generally known that relative humidities in residences are low during the winter, definite information as to the actual humidity conditions which exist in buildings under normal conditions of occupancy is very scarce. In this paper is reported the results of a survey made by the students of a number of colleges, located throughout the country, of the actual relative humidities carried in occupied dwellings.

As it was to be expected, the relative humidity in occupied houses decreases as the outside temperature decreases. Of more interest was the fact that the average effect of all sources of additional moisture in all occupied houses is to raise the relative humidity some 10% in relative humidity above what it would be in a house which was heated but not occupied. Another interesting point is that in houses with some provision for humidification, the relative humidity was on the average only 5% higher than in un-humidified houses. It should be pointed out that conditions in individual houses may depart widely from the average and therefore it is difficult to form any definite rules.

[*"Building Materials and Structures. Report BMS56, a Survey of Humidities in Residences," by Thomas D. Phillips. Published by the National Bureau of Standards, United States Department of Commerce. Paper cover; 8½ x 11 in.; 6 pages. For sale by the Superintendent of Documents, Washington, D. C. Price, 10 cents.*]

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Pumps

An enlarged completely re-written and re-arranged seventh edition of standards for the pump industry. Among the new material which has been added is included information on the new pump test code, charts for figuring friction of petroleum products in pipe lines, specific pump speed curves, pressure temperature curves for pumping hot water and chart showing resistance of valves and fittings to flow of fluids.

The book is divided into seven sections entitled as follows: General, Centrifugal, Rotary Pump, Reciprocating Pump, Deep Well Turbine, Test Code — For Centrifugal, Rotary and Reciprocating Pumps, and Data Section.

[*"Standards of the Hydraulic Institute, Seventh Edition." Published by the Hydraulic Institute, 90 West Street, New York, N. Y. Paper cover; 8½ x 11 in. About 150 pages. Price, $1.25.*]

Humidity Damage

Current trends in construction of certain types of buildings, coupled with the present-day tendency to carry higher humidity than formerly during the wintertime, have greatly increased the potentiality for moisture damage due to condensation from the air.

In general there are two principal methods whereby condensation damage can be prevented: (1) By carrying lower humidity within the structure; and (2) by structural means, which will prevent moisture in large enough concentration to permit condensation from reaching or being retained at the cold parts of the structure. The first method, which depends upon suitable limitation of moisture release (and in some cases even upon dehumidification of the air) may not always be acceptable owing to process requirements. Hence improved methods of construction may be essential for some types of buildings.

In the main, the first solution, while the ideal, is not easy to achieve in existing buildings, although to an extent, it can be approached. Where a high winter humidity is not essential, the second solution is the more certain and can be attained by proper control of the sources of humidity in relation to the weather.

Attempts have been made to employ an outdoor thermostat linked to an indoor humidistat, so designed that the humidistat is automatically reset to an assumed safe point as the outdoor temperature falls. This arrangement, however, does not take into consideration the increased heat transmission of building materials with increased wind velocity. A much simpler arrangement developed by the authors (U. S. Patent No. 2,210,656) is available. This device is a hair humidistat which is supported close to the glass of a window (without storm sash) so that the thermal circulation of air cooled by heat transmission through the pane contacts the humidistatic element. Since a window (preferably one on the north) is normally the best heat transmitting element in a structure, the air passing the element will be the coldest and hence at the highest relative humidity that air within the walls will reach. Thus if the humidistat is set to shut off the humidifier or start a ventilator or dehumidifier when the air cooled by the window reaches 90 per cent relative humidity, trouble from condensation will not usually be encountered.

There is, however, this exception: weather changes in winter may be rapid and extreme. If only a window humidistat were used it would be possible for the interior humidity to go so high during the warm period that infiltration or ventilation could not lower it safely in step with the rapidly falling outside temperature. To handle this situation the authors have developed a simple modification of the window humidistat system, whereby a second humidistat in series with the first and exposed to the average room air acts as a limiting control, holding the inside humidity to, say, 35 or 40 per cent regardless of the outside temperature (U. S. Patent No. 2,171,109).

When reduction in humidity cannot be practiced as a deterrent to condensation, then the remaining recourse is by some means to limit the quantity of vapor that can accumulate in contact with the cold parts of the structure. Either an adequate vapor seal must be used to keep the vapor in higher temperature parts of the structure, or the cold parts must be so well ventilated that vapor cannot accumulate to a concentration high enough to condense.

Structural means should be provided for ventilating the wall outside the insulation and in addition, if possible, a vapor sealing membrane which is largely impervious to moisture diffusion should be provided *inside* the studding, and under the plaster or other inner wall surface.

Plywoods made with synthetic resin cements may be another solution, as well as other impervious synthetic or metal-covered materials. Investigations of various types of paint coatings over the plaster and of certain improved building papers have shown that some of these materials serve adequately as inside vapor seals. (See Rowley, loc. cit.; Univ. Illinois Bull. Vol. 36, p. 104, 1939; and bulletins of the Forest Products Laboratory, Madison, Wis.)

[*"Humidity Damage to Buildings and Means for Its Prevention," by C. R. Downs and J. W. Spiselman. Published in Chemical & Metallurgical Engineering, 330 W. 42nd St., New York, N. Y., Sept., 1940, page 620. Price, single issues, 35 cents.*]

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Housing for Defense

Probably the most basic finding of this survey is that private industry has the capacity to provide the major part of the housing needs of our defense program, but an immediate plan of action for defense housing is necessary if we are to avoid the delays and mistakes that seriously crippled America's war effort in 1917-1918.

The report finds that the private building industry faces the present emergency with more favorable factors than in 1917-1918. No general labor shortages in construction or manufacturing threaten us. Building materials of all kinds are readily available. There is, moreover, no likelihood of a general shortage of funds to lend for sound housing operations. In contrast to the last crisis, there is real momentum now behind the housebuilding program. Today, the skill of designers and the capacity of builders are both much greater than they were twenty-three years ago. This is especially true in the low-priced field.

However, the research staff sharply warns against undue optimism. With all the advantages of the present situation we may still be confronted by many critical situations. Industrial expansion has hardly begun, yet the names of many of the trouble centers of the last war are heard again.

For today's needs, the Fund's Committee recommends that defense housing should be of permanent, not temporary construction; and it should be concentrated in the low-cost field.

The report shows that for a typical group of defense industries about 30% of the workers will be making an average of $50 per week; another 40% of the workers will average $29 weekly; and the remaining 30% about $20 weekly. The needed housing will have to be suitable for income ranges such as these. More specifically, says the report, this means a house which

should fall in a cost range of from $2500 to $4000, including land, for at least a two-bedroom unit, with corresponding monthly rentals of $20 to $35 without light or fuel.

On the question of whether government or private industry should supply the greater part of defense housing, the Committee says that government policy should encourage the continuance of private building effort over a wide area and the government itself should enter upon any phase of direct operation only on good evidence that private means are no longer available for, or capable of, meeting the need.

[*"Housing for Defense—A Review of the Role of Housing in Relation to America's Defense and a Program for Action." Factual findings by Miles L. Colean; the program by The Housing Committee. Published by the Twentieth Century Fund, 330 West 42nd St., New York, N. Y. Heavy cardboard cover; 6 x 9¼ in.; 198 pages. Price, $1.50.*]

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Drafting Room Practices

Drafting room practice is undergoing constant change. New and more efficient methods and devices are constantly being introduced. The authors had noted that in many cases drafting teaching practice lags behind drafting room practice due to the fact that the new ideas have not found their way into text books. The purpose of this study was to determine the present practices in industrial drafting and thus form a basis for comparison between the courses as now taught and the actual practice in industry.

There is much valuable information in this book for practicing draftsmen and teachers of drafting. Because of the large amount of information included in this study, it is difficult to summarize it. However, some of the more important conclusions are as follows:

(1) There appears to be an increase in the use of pencil cloth and tracing paper and a decrease in the amount of ink work done. (2) Many industries are now using drafting machines and the college course should provide the student with some practice on these machines. (3) Students should have some practice in the use of mechanical lettering devices as these are in extensive use, particularly in work which is to be photographically reproduced. (4) A young engineer should be familiar with the use of the slide rule, calculating machine, pantograph and planimeter.

[*"Drafting Room Practices," by T. C. Brown and P. E. Moose. Bulletin No. 21, Engineering Experiment Station, State College Station, Raleigh, N. C. Published by North Carolina State College of Agriculture and Engineering, University of North Carolina. Paper cover; 6 x 9 in.; 86 pages. Price, 25 cents.*]

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Plumbing

A manual of recommended plumbing practice which is intended to serve as a guide for the work of various agencies of the Federal government. Particular emphasis is placed on its usefulness in low-cost housing where there is a special need to take advantage of legitimate economies. The field of the manual, however, is not restricted to housing, since the same fundamental principles apply in buildings of most types.

The manual consists of three parts, Part 1 being merely an introduction which explains the origin of the work; Part 2 explains recommended practices against pollution of water supply, permissible types of venting and other matters covered in plumbing codes, while Part 3 contains information useful in applying the recommendations including illustrations and interpretations of the specific requirements in Part 2.

In a foreword to this manual, Lyman J. Briggs, Director of the National Bureau of Standards, states that it is hoped that the report will prove useful not only for Federal plumbing work but also to bring about a uniformity in plumbing requirements and reduce the cost of construction of which plumbing forms a part.

[*"Building Materials and Structures, Report BMS66, Plumbing Manual." Published by the National Bureau of Standards, United States Department of Commerce, Washington, D. C. Paper cover; 8½ x 11 in.; 70 pages. For sale by the Superintendent of Documents, Washington, D. C. Price, 20 cents.*]

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General Engineering Handbook

In the eight years since the first copy of this book appeared, it has become widely accepted as a book of fundamental engineering data which is particularly useful to engineers who have a need for knowledge in branches other than the one they are practicing in. In this second edition, the editors have made many improvements based on suggestions received from users of the book.

One definite improvement that readily makes itself evident is the elimination of some of the more highly specialized sections such as on water power plants and electrical equipment. In place of these sections, the more basic sections have been expanded. Many of the other sections have been combined in order to obtain a better sequence of related material and to avoid a duplication of facts. Approximately 200 pages have been added to the book.

The book is to be recommended to all heating, ventilating and air conditioning engineers who are in need of basic information in other branches of engineering. The book covers heating and air conditioning but, as is to be expected, is written to meet the needs of other than heating and air conditioning engineers, and therefore includes only the more fundamental data.

The following list of chapter headings gives a good idea of the material covered: Mathematics; Mathematical Tables; Physical Tables; Engineering Materials; Theoretical Mechanics; Hydraulics; Structural Theory and Design; Plain and Reinforced Concrete; Foundations; Topographical and Geodetic Surveying; Route Surveying and Earthwork; Highways; Municipal Sanitation; Machine Elements; Pumps, Compressors, and Hydraulic Turbines; Engineering Thermodynamics; Heating and Air Conditioning; Fundamentals of Electrical Engineering, and Electrical Measurements.

[*"General Engineering Handbook," by Charles E. O'Rourke. Published by the McGraw-Hill Book Company, 330 West 42nd Street, New York, N. Y. Flexible binding; 5½ x 8 in.; 1120 pages. Price, $4.00*]

Market for Engineering Services

The American Association of Engineers recently made a survey of the probable market for engineering services during the period of 1940-1950. The results of this survey which are reported in this bulletin contain much of interest to every engineer whether he is an employer of engineers, or an employee. For employers, this bulletin should be of considerable help in determining the approximate range of compensation which prevails for the particular type of job he is trying to fill, while for the employee it should be of help in showing him just how his salary compares with salaries of other engineers in the same classification.

This study has brought out a number of interesting facts, as for example, the salaries of professional engineers in classification above draftsmen are lower at the present time than they were in 1932. On the other hand, the volume of engineering placements for the first eight months of 1940 was approximately equal to the volume in 1930. Another point of considerable interest is the fact that the current market for men over 40 and 45 is better than it has been for twelve years. An unusual development, probably the result of recent legislation, is the fact that hourly wage scales, not only for draftsmen, but also for higher classifications, are now common. There is reported 800% increase in placements at hourly rates in 1940 as compared to 1929.

[*"The Market for Engineering Services 1940-1950." Published in the Professional Engineer, official publication of the American Association of Engineers, 8 South Michigan Ave., Chicago, Ill. Paper cover; 6 x 9 in.; approximately 63 pages. Price, 50 cents to non-members.*]

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Water Heaters

A report of an investigation made to determine the effect of temperature on scale formation in water heaters is presented in this publication. Mr. Krappe reports that previous to these tests many persons had noted that scale formation increases rapidly at high water temperatures but that no experimental work had been done to determine whether temperature was a major factor in the formation of scale deposits in water heaters. To furnish such information, accelerated scale tests were performed on gas fired water heaters over a period of two years, also the study was made of field experiences in hard water scale formation.

As a result of these studies it was concluded that water temperature is the principal factor causing scale formation in water heaters. It was noted that a very rapid increase in the rate of scale formation is obtained between 180 and 140F; in fact the rate of scale formation at the higher temperature was found to be seven times as great as that at the lower temperature. It was reported that at the temperatures below the boiling point, temporary hardness in the form of calcium bicarbonate is the component of the water supply which accounts for nearly all of the scale formed. It was also shown that the scale deposits at 180F will obstruct outlet pipes from the heater before enough material has been formed in the heater to interfere with its operation.

The experiment showed that scale formation can be reduced by carrying as low a temperature as possible in the water heater. Where high temperature water must be provided, scale formation may be prevented by adding small proportions of chemical such as hexametaphosphate to the water.

[*"Scale Formation in Water Heaters and Methods of Prevention," by J. M. Krappe. Research Series No. 74, Engineering Experiment Station, Lafayette, Indiana. Published by Purdue University, Lafayette, Indiana. Paper cover; 6 x 9 in.; 27 pages. Price, 25 cents. A limited number of copies available without charge.*]

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Boiler Reference Book

For the first time there is available in one volume the ratings and specifications on domestic heating boilers of both old and current manufacture. The tables are limited to boilers rated up to 2000 sq. ft. of steam radiator surface and include the following information: Boiler Model Number; Rating, steam and water; Minimum Firing Rate, gallons oil per hour and pounds coal per hour; Heating Surface, square feet; Firebox, width and length; Floor to Crown Sheet; Grate Size; Floor Area; Base Height; Chimney, size and height; Smoke Pipe, diameter.

All of the data listed has been obtained from boiler manufacturers or their literature. The tables are preceded by a brief explanation.

The book should be extremely valuable to heating contractors and engineers who are interested in obtaining the rating or other information on heating boilers. The book is much easier to use than previous books of this kind because all of the data is tabulated in the same form and because the ratings appear in one volume. The directory of boiler manufacturers which appears in the back of the book will be specially valuable in locating manufacturers or companies which can supply boiler parts. As a matter of fact, it might be worthwhile to expand this section in the next edition to include all suppliers of boiler parts whether they are boiler manufacturers or not.

[*"Beacon Boiler Reference Book." Published by Heating Journals, Inc., 232 Madison Avenue, New York, N. Y. Heavy paper cover; 5¼ x 8¼ in.; 554 pages. Price, $3.00.*]

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Sheet Metal Work

This is a booklet which explains in simple shop language an improved shortcut to sheet metal pattern drafting. The material has been reprinted from a series of articles written by Ralph W. Poe and which appeared originally in the "Ingot Iron Shop News." The author obtained a knowledge of this method years ago while serving an apprenticeship under an old-time master craftsman and he devoted a considerable amount of time to finding out how the method worked and why. The articles were very well received when they were originally published and because of this, the American Rolling Mill Company has put this short series into booklet form. The book covers such sheet metal transition problem as square to round, oval to round, rectang-

ular to round, square to round elbows, "Y" joints, oval to round elbows, tee joints, off-center tees, and angular intersections.

[*"Short Method of Pattern Development," by Ralph W. Poe. Published by the American Rolling Mill Company, Middletown, Ohio. Paper cover; 6 x 9 in.; 48 pages. Price, 30 cents to cover production and mailing costs. Residents of Ohio should include an extra cent for sales tax.*]

BRIEF REVIEWS

RESEARCH. An outline of engineering data which are available through the various channels of publication of the American Society of Heating and Ventilating Engineers. Also includes a bibliography of research reports emanating from the ASHVE laboratory and cooperative institutions covering work done on a variety of subjects over a period of twenty-one years. Also contains information on organized and experienced research laboratory facilities which are available for investigating special heating, ventilating and air conditioning engineering problems. [*"Outline of Research Facilities and Bibliography of Research Reports." Published by the American Society of Heating and Ventilating Engineers, 51 Madison Avenue, New York, N. Y. Paper cover; 6 x 9 in.; 10 pages. Available on request from the ASHVE.*]

WARM AIR HEATING. This booklet attempts to explain for the benefit of the home owner what constitutes a good forced air heating system, what specifications he and his architect should have for a Class A or B installation and what specifications a heating contractor can offer for the best modern heating practice. Statements made in this book are based on accepted practice and on results of the twenty-two-year research program conducted by the National Warm Air Heating and Air Conditioning Association at the Engineering Experiment Station of the State of Illinois. Requirements specified in the Code published by the Association and other organizations have been included in this booklet. [*"A Yardstick for the Evaluation of a Forced Warm Air Heating System." Published by the National Warm Air Heating and Air Conditioning Association, 5 East Long Street, Columbus, Ohio. Paper cover; 8½ x 11 in.; 23 pages. Price, 25 cents.*]

STOKERS. Commercial standard for domestic burners of Pennsylvania anthracite effective for new production from November 30, 1940. [*"Domestic Burners for Pennsylvania Anthracite, CS48-40." Published by the National Bureau of Standards, United States Department of Commerce, Washington, D. C. Copies available on request by writing to the National Bureau of Standards.*]

CLIMATE. Useful information regarding the climate between the Rocky Mountains and the Atlantic coast with special reference to Maryland and Delaware. [*"Our Climate," prepared by John R. Weeks. Issued by the Maryland State Weather Service Bureau, Custom House, Baltimore, Md. Paper cover; 6 x 9 in.; 66 pages. Available from the Maryland State Weather Service Bureau.*]

AIR CONDITIONING STANDARDS. A code of application engineering standards for air conditioning for comfort, prepared as recommended practice for members of the Air Conditioning & Refrigerating Machinery Association. Code is designed to supplement individual company practice and data prepared and published by technical societies. The code is limited to application engineering standards and practices for determining the conditions and the loads for which to design systems for conditioning air for the comfort of persons within the United States. These are minimum standards and are to be construed as defining recommended practice, rather than as hindering progress or as preventing the use of other standards where such are justified by the economies of a case and where departures below good practice minimums are made clear to the buyer. [*"Code of Application Engineering Standards for Air Conditioning for Comfort." Published by the Air Conditioning & Refrigerating Machinery Association, Southern Building, Washington, D. C. Paper cover; 5 x 7 in.: 22 pages. Price, 20 cents.*]

ELECTRIC DIRECTORY. A ready reference of the consumers current supply characteristics indicating the type of supply that is A.C. or D.C. and the phase, frequency and voltage in the principal cities of the world other than the United States. [*"World Directory of Electric Current Characteristics," compiled by E. S. Moore and published by E. S. Moore at 704 West Ninth St., St. Louis, Mo. Heavy cardboard cover; 8½ x 11 in.; 62 pages. Price, $5.00.*]

ENGINEERING UNITS. A paper which attempts to clarify the problems which arise when converting from one system of engineering units to another. Paper indicates the relation between the three systems in common use. [*"English Engineering Units and Their Dimensions," by E. W. Comings. Published by the Engineering Experiment Station, Reprint Series No. 18, University of Illinois, Urbana, Ill. Paper cover; 6 x 9 in.; 10 pages. Price, 15 cents.*]

REFRIGERATION. A revised printing of this book on the principles and practice of refrigeration engineering. Includes a number of new tables on the thermodynamic properties of refrigerants and also some new data on the flow of fluids and heat transfer. [*"Refrigerating Engineering," by H. J. MacIntire. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York, N. Y. Cloth bound; 6 x 9 in.; 439 pages. Price, $4.50.*]

AMMONIA CONDENSERS. Equipment standards for the performance of ammonia condensers, both vertical open shell-and-tube type and horizontal closed shell-and-tube type. [*"Equipment Standards, Performance of Ammonia Condensers," formulated by the Air Conditioning and Refrigerating Machinery Association, Inc., Southern Building, Washington, D. C. Paper cover; 8½ x 11 in.; 8 pages and 3 charts. Price, 25 cents.*]

PHOTO RELAYS. A review of the theory and applications of the photo relay or light operated relay. [*"Photo Relays — Their Theory and Application," by F. H. Shepard, Jr. Published by the Allied Control Company, Inc., 227 Fulton St., New York, N. Y. Heavy paper cover; 6 x 9 in.; 25 pages. Price, 25 cents.*]

Number of Degree-Days for December, 1940

HEATING & VENTILATING continues its thirteenth year of publishing degree-day data for various large cities. Forty-four cities have been added to those previously published, making a total of 114 cities listed below.

	Degree-Days December, 1940	Degree-Days Cumulative
Albany, N. Y.	1127	2700
Alpena, Mich.	1161	2810
Atlanta, Ga.	534	1038
Atlantic City, N. J.	725	1663
Baker, Ore.	984	2638
Baltimore, Md.	685	1528
Binghamton, N. Y.	1025	2539
Birmingham, Ala.	445	869
Bismarck, N. D.	1334	3168
Boise, Idaho	921	2288
Boston, Mass.	953	2178
Buffalo, N. Y.	996	2409
Burlington, Vt.	1284	3019
Cairo, Ill.	671	1337
Canton, N. Y.	1341	3140
Charles City, Iowa	1254	2723
Charlotte, N. C.	556	1105
Chattanooga, Tenn.	645	1371
Cheyenne, Wyo.	1039	2650
Chicago, Ill.	977	2120
Cincinnati, Ohio	779	1704
Cleveland, Ohio	877	2039
Columbia, Mo.	837	1732
Columbus, Ohio	810	1875
Concord, N. H.	1178	2735
Concordia, Kan.	992	1977
Davenport, Iowa	1010	2109
Dayton, Ohio	845	1904
Denver, Colo.	915	2083
Des Moines, Iowa	1077	2215
Detroit, Mich.	1021	2364
Dodge City, Kan.	839	1723
Dubuque, Iowa	1105	2397
Duluth, Minn.	1431	3298
Eastport, Me.	1186	2961
Elkins, W. Va.	755	2045
El Paso, Tex.	452	932
Erie, Pa.	910	2167
Escanaba, Mich.	1263	2961
Evansville, Ind.	750	1634
Fort Smith, Ark.	589	1119
Fort Wayne, Ind.	957	2180
Fort Worth, Tex.	945	878
Grand Rapids, Mich.	1027	2361
Green Bay, Wis.	1261	2791
Greensboro, N. C.	656	1433
Harrisburg, Pa.	853	2013
Hartford, Conn.	1006	2392
Helena, Mont.	1125	3021
Huron, S. D.	1256	2756
Indianapolis, Ind.	847	1813
Ithaca, N. Y.	1008	2531
Kansas City, Mo.	859	1725
Keokuk, Iowa	920	1905
Knoxville, Tenn.	583	1263
La Crosse, Wis.	1231	2690
Lander, Wyo.	1273	3085
Lansing, Mich.	1081	2588
Lincoln, Neb.	1050	2114
Little Rock, Ark.	518	1007
Los Angeles, Calif.	156	279
Louisville, Ky.	701	1457
Lynchburg, Va.	650	1425
Madison, Wis.	1205	2619
Marquette, Mich.	1232	2913
Memphis, Tenn.	514	999
Milwaukee, Wis.	1099	2402
Minneapolis, Minn.	1335	2913
Nantucket, Mass.	818	1954
Nashville, Tenn.	584	1227
New Haven, Conn.	912	2119
New Orleans, La.	186	349
New York, N. Y.	810	1847
Norfolk, Va.	521	1097
Northfield, Vt.	1341	3234
North Platte, Neb.	1053	2263
Oklahoma City, Okla.	682	1328
Omaha, Neb.	1068	2191
Oswego, N. Y.	1066	2526
Parkersburg, W. Va.	708	1722
Peoria, Ill.	962	2065
Philadelphia, Pa.	764	1710
Pittsburgh, Pa.	762	1837
Pocatello, Idaho	1056	2645
Portland, Ore.	650	1528
Providence, R. I.	916	2135
Pueblo, Colo.	1000	2189
Raleigh, N. C.	553	1154
Reading, Pa.	833	1979
Reno, Nev.	842	2067
Richmond, Va.	640	1406
Rochester, N. Y.	1061	2529
Roseburg, Ore.	661	1467
St. Joseph, Mo.	936	1864
St. Louis, Mo.	780	1532
Salt Lake City, Utah	937	2058
Sandusky, Ohio	936	2125
San Francisco, Calif.	292	683
Sault Ste. Marie, Mich.	1281	3149
Scranton, Pa.	970	2389
Seattle, Wash.	574	1489
Sioux City, Iowa	1119	2404
Spokane, Wash.	967	2407
Springfield, Ill.	885	1797
Springfield, Mo.	791	880
Syracuse, N. Y.	1075	2581
Tacoma, Wash.	630	1665
Terre Haute, Ind.	842	1763
Toledo, Ohio	964	2220
Trenton, N. J.	821	1933
Utica, N. Y.	1123	2713
Washington, D. C.	682	1553
Wichita, Kan.	852	1699
Yakima, Wash.	952	2199

NEWS OF THE MONTH

Four Refrigeration Associations Hold Conventions in Chicago; Over 9000 Attend Refrigeration and Air Conditioning Show

CHICAGO—Meetings of four associations and exhibition on refrigeration and air conditioning drew thousands of refrigeration and air conditioning men to this city during the week of January 13-17.

The National Air Conditioning Association, National Refrigeration Supply Jobbers Association, and the Refrigeration Service Engineering Society all held their annual meeting during this week while the American Society of Refrigerating Engineers sponsored the First National Conference on Refrigeration Selling. At the same time the 3rd All Industry Refrigeration and Air Conditioning exhibition which is sponsored by the Refrigeration Equipment Manufacturers Association, was held.

All of the conventions and the exhibition reported attendance far ahead of last year. Over 9000 persons registered to see the exhibition in which approximately 200 exhibited spaces were occupied by 130 exhibitors. The total attendance at this exhibition was approximately 18% higher than it was last year.

At the second annual meeting of the National Air Conditioning Association the members re-elected Jesse W. Page, Jr., of Charlotte, N. C., as president; J. N. Sprekelmeyer of Fort Worth, Tex., as vice-president, and A. C. Buensod, of New York City as treasurer. They also elected as directors of the association, J. W. Bostwick, H. C. Levine, and J. M. Sprekelmeyer. A. F. Callahan of New York City remains as executive secretary.

It was reported that the Society has approximately 90 members, not including the new members secured during the convention.

An amendment to the constitution was made so that persons, such as consulting engineers, who are engaged in the design of air conditioning systems, can be admitted to full membership in the association.

The Refrigeration Service Engineers at their 7th annual convention elected E. A. Plesskott of St. Louis, president; Clarence Bushkopf of Beaver Dam, Wis., 1st vice-president, and A. W. Gruber of Irontown, Ohio, 2nd vice-president. S. A. Leitner, Kansas City, and H. T. McDermott of Chicago, were re-elected to the offices of treasurer and secretary, respectively.

At the technical session of this Society papers were presented on the following subjects: "Problems of Refrigerant Distribution Through Multi-Circuit Coils," by A. B. Schellenberg; "Properties and Characteristics of Refrigerants," by R. J. Thompson; "Air-O-Matic Absorption System," by Glenn F. Zellhoefer, and "Why Fins?" by Israel Kramer.

At the final session L. C. McKesson conducted a "take-it-or-leave-it" contest in which questions on various technical subjects were used.

9 Cities Get Defense Housing

WASHINGTON—Federal Works Administrator John M. Carmody announced recently construction assignments for nine projects totalling 1965 dwelling units to be built under the Lanham Defense Housing Act.

Included in these assignments are four projects each for the United States Housing Authority and the Public Buildings Administration and one for the Farm Security Administration of the Department of Agriculture.

The assignments are as follows:

United States Housing Authority:	
Brooklyn, New York	200 units
Erie, Pennsylvania	500 units
Orange, Texas	200 units
Public Buildings Administration:	
Hinesville, Georgia	100 units
Rantoul, Illinois	100 units
Portsmouth, Virginia	565 units
St. Julien's Creek, Virginia	100 units
Farm Security Administration:	
Radford, Virginia	200 units

Mr. Carmody's action was based on the finding of the President that "an acute shortage of housing which would impede national defense activities exists or impends" in the localities named, and further "that such housing would not be provided by private capital when needed."

The action brings the total assignments to PBA to 75 projects consisting of 17,977 units, and the total to USHA to 13 projects or 5900 units, under the Lanham Defense Housing Act.

Mass. Oil Heating Assn. Formed

BOSTON—With the Jan. 14 dinner meeting, the Boston Oil Burner Associates became the Massachusetts Oil Heating Association, its membership expanding to include oil burner, fuel oil and other heating men in cities and towns throughout Massachusetts. Previously its membership had been confined to members of those industries in metropolitan Boston. Officers of the new association were elected, as follows: President, Charles L. Cronin; vice-president, Joseph F. Walsh; secretary-treasurer, Fred N. Beckwith; executive committee, Lawrence Holman, Clyde Morrill, Ralph Dennis and Charles Soper.

A.C. Council Installs Officers

BUFFALO, N. Y.—New officers of the Air Conditioning Council of Western New York installed at the January meeting were Richard H. Mollenberg, president; Walter A. Voisinet, vice president; Walter P. Davis, executive secretary, and Harry C. Schafer, treasurer. In his installation talk, Mr. Mollenberg said he would bend every effort to provide the Council with a progressive, constructive program in the coming year.

"We will seek to build the Council's membership to a new peak and to broaden its influence throughout the Western New York area," Mr. Mollenberg declared. He hinted that the Council will look over the winter air conditioning code here "and possibly make some revisions."

He paid high tribute to Mr. Cooney for his work as president of the organization during the past year and then presented him a plaque as a token of appreciation from the Council. Mr. Cooney, who is a director of the new National Air Conditioning Association, then spoke briefly on progress in that organization.

"The national association had tough sledding during its first year but it now looks as though we are going somewhere," he declared. "The national organization can do more good for air conditioning than any association I know of today."

Draft to Affect Labor Supply

NEW YORK—The effect of the defense program on the plumbing and heating contracting labor situation is revealed in a survey covering New York State made in November by *The Ladle*, official publication of the New York State Association of Master Plumbers.

The survey shows that in Brooklyn, for example, 25% of the plumbers and 15% of the steamfitters will be affected by the draft; that 150 men will be affected in the Rochester area; about 50% of the helpers will be affected in Suffolk County and that defense work at Camp Upton may take two-thirds of the labor supply at a later date; and that the operation of big defense plants in Utica is expected to make serious inroads in the future.

Approximately 2600 of Brooklyn's 2950 journeymen are now employed, but this ratio is higher than in Manhattan and the Bronx where only 1500 of the available 2500 are working. Schenectady and Elmira report all journeymen employed while some of the smaller communities, such as Amsterdam, have almost reached a saturation point.

News of the Month

Carrier Employes Get Bonus

SYRACUSE, N. Y.—Under the unique "Share the Fortunes of the Company" salary plan announced in December, 1939, salaried employes of the Carrier Corporation have received cash bonuses averaging 2.4% addition to salaries per month, and equaling one week and one day of extra salary for the year, it was announced today by Mr. J. I. Lyle, president of the firm.

"The business of Carrier Corporation is improving and 1941 should be a year of excellent sales volume," Mr. Lyle said. "And our employes now realize, I believe, that they will be rewarded individually by helping make this increased business genuinely profitable. In other words, the extra salary payments during 1940 have brought home the fact that individual effort results in better profits that are shared by employes as well as stockholders."

When the plan was announced in December, 1939, it was heralded as an important advance in employer-employe relations. The result of a nine-month study and field survey by J. A. Bentley, vice-president in charge of finance, it embodied new features not included in any known industry salary project.

Under the plan, every salaried worker shares in direct proportion to the fortunes of the company. During each month, the company computes its average net income or loss for the preceding twelve months without reserve or reduction for income or profit taxes. Salaries are then adjusted on a percentage basis, determined by dividing 20 per cent of the previous 12 months' average monthly net income or loss by the total base salaries of all employes for the current month. The salary paid to each employe for that month represents his base salary plus or minus this percentage.

More than 60 other salary plans now operating in America's leading industries were studied before the plan was evolved.

N.Y. Factory Building at New High

ALBANY, N. Y.—Financial Investment of $4,096,720 represented by the 134 industrial building plans filed for approval with the Engineering Division of the State Labor Department in December is the greatest ever anticipated by plans filed during a December in the 17-year records of such plans, Industrial Commissioner Frieda S. Miller has reported.

Plans filed in December bring the total number for 1940 to 1777, a record number for any year, exceeding by three the previous all-time high.

The total amount of investments represented by the plans submitted in 1940 is $35,416,059, second highest for 17 years, being exceeded only by the $43,209,792 of 1927.

The number of plans filed during December, 1940, exceeds the December average for the previous 16 years by 83 per cent.

N.J. Plant Building Breaks Record

TRENTON, N. J.—New Jersey industrial construction established a new high record during 1940, according to announcement here by the State Labor Department, which revealed it had approved a total of 1124 plans involving an estimated outlay of $18,739,984 during the year. The previous high was in 1928, when 420 plans were approved for expenditure of $16,749,503.

The 1940 uptrend in industrial building activity continued through December, when 137 plans were approved for an outlay of $2,784,543. This was four times the average for that month and exceeded the total for the entire 12 months in 1931, 1932, 1933 and 1934.

The December report indicated there were 56 more plans approved and $835,489 more in expenditures than during the corresponding month of the preceding year. About one-third of the plans were related to the national defense program.

OBI Phila. Program Announced

NEW YORK—Convention sessions of unusual interest and importance are announced by Oil Burner Institute in connection with the National Oil Burner Progress Exhibition and Convention to be held in Philadelphia March 17-22.

Two convention sessions will be held. The engineering session, scheduled for Wednesday morning at the Benjamin Franklin Hotel, will have as its chairman Ross M. Sherman, president of Silent Glow Oil Burner Corporation and chairman of the OBI Standards Committee.

While standards and tests will be fully treated by speakers at this session, other engineering subjects will be discussed, including an important paper on "Chimneys" which will be given by W. O. Lum, consulting engineer, Air Conditioning and Commercial Refrigeration Department of General Electric Company.

R. K. Thulman, mechanical engineer with the Technical Division of Federal Housing Administration, will speak on the commercial standard from the standpoint of FHA requirements. R. S. Dill, mechanical engineer of U. S. Department of Commerce, National Bureau of Standards, will speak on the bureau's heating equipment tests. C. R. Welborn, secretary of Underwriters' Laboratories will speak on the laboratory facilities and methods in connection with commercial standards.

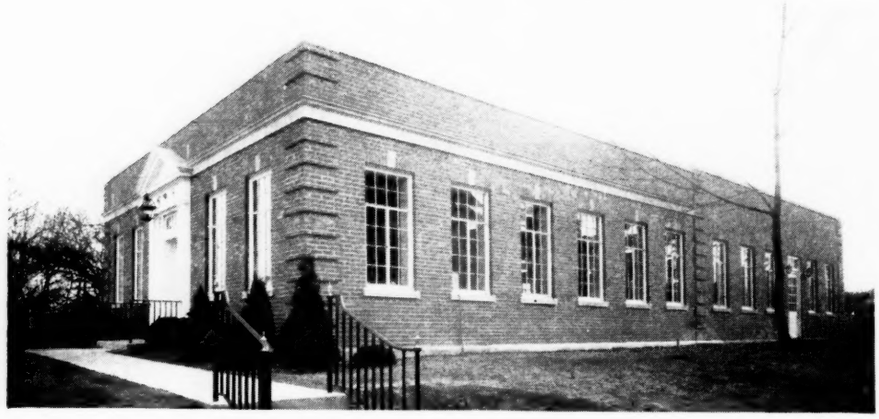
The Merchandising Session on Thursday, March 20, will be preceded by a breakfast at which Oil Burner Institute will be host. Chairman of the session will be C. E. Lewis, general sales manager, Delco Appliance Division, General Motors Sales Corporation.

The National Oil Burner Progress Exhibition already has broken all records for space taken and number of exhibitors, as compared with all the shows sponsored by OBI.

Oil Heats Calif. Air Field

RIVERSIDE, CALIF.—Oil has been specified as the fuel to be used in the central heating plant at March Field, which is located on the outskirts of this city. Butane will be used for cooking and for supplying domestic hot water. It was reported that the California Oil and Gas Association had actively campaigned to get the Army to use oil and gas at this Field in place of coal. It was said that the association pointed out that California did not produce any coal but is the nation's second largest producers of oil and gas.

It was also learned that studies were being made on the fuel requirements at the other camps at California, for the petroleum products to be used instead of coal.

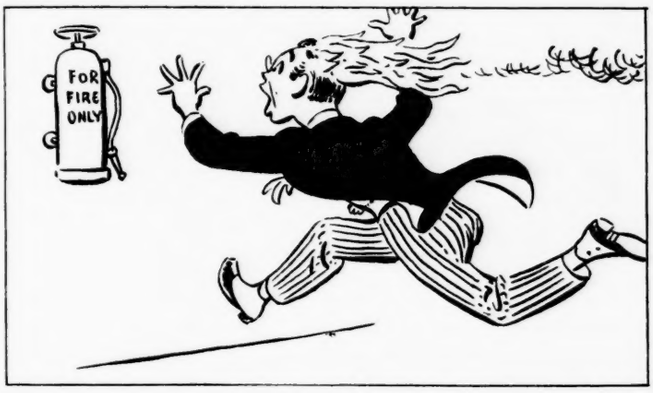


The Mason-Neilan Regulator Company has enlarged its quarters at Dorchester, Mass., where this attractive new building was erected by The Austin Company. The building provides increased office space and has made available a larger area for assembly of the company's pressure, temperature, flow and combustion control regulators.

Points to remember...when you specify air filters!

1. Your Treasurer will be tickled to death, if you specify Dust-Stop* Air Filters. They cost about 1¢ per CFM to install, including frames. And that's not all! They set you back the trifling amount of about 1/10 cent per CFM when they need changing!

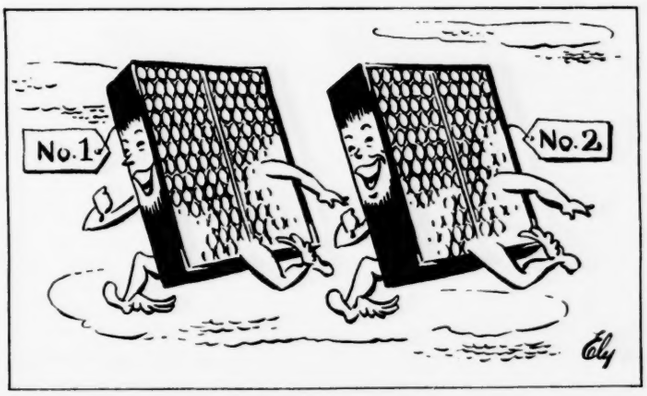
2. And, boy! Do Dust-Stops call the score on dust! They keep out virtually all the "nuisance" varieties. Capacity: 2 CFM per sq. inch of area at 300 FPM. Average resistance, new (in inches of water gauge): .065 for 1-inch; .125 for 2-inch Dust-Stops.



3. You need never have fire on your mind, with Dust-Stop Air Filters. *Neither* the glass-fiber filtering medium nor the patented adhesive will support combustion! Dust-Stops are safer because the fire hazard just doesn't exist!

4. Nor will anybody be able to make a goat out of you because of adhesive droplets inside the duct system, or on the walls. Dust-Stops positively will not bleed! That's another advantage you *have* when you use these replaceable filters.

5. Changing Dust-Stops is about as hard as changing your face from a frown to a smile. No skilled labor required. No draining, recharging, or supervision needed, either. And no need to keep a supply of spares. Dust-Stops fit most types of air systems.



6. Dust-Stops will come to you quickly, if you'll just phone your air conditioning manufacturer, jobber, or dealer. You can choose either the No. 1 (1-inch) or No. 2 (2-inch). Or write to Owens-Corning Fiberglas Corporation, Toledo, Ohio. In Canada: Fiberglas Canada, Limited, Oshawa, Ontario.

FIBERGLAS* DUSTOP* AIR FILTERS

*T.M. Reg. U. S. Pat. Off.

Made by Owens-Corning Fiberglas Corporation, Toledo, Ohio

DIRECT CANADIAN INQUIRIES TO FIBERGLAS CANADA, LIMITED, OSHAWA, ONTARIO

News of the Month

York Considers Name Change

YORK, PA.—The York Ice Machinery Corporation has issued a call for a special meeting of its stockholders to vote on a proposal which, if adopted, will effect a recapitalization and change its name to York Corporation. The plan contemplates that York Ice Machinery Corporation will merge with its subsidiary York Corporation. If the merger is approved the surviving corporation will have 962,646 shares of common stock authorized and outstanding which will be issued on the basis of fifteen shares for each existing share of preferred stock and one share for each existing share of common stock of York Ice Machinery Corporation. This will result in the distribution of 83.2% of the new stock to the present preferred stockholders.

The company stated that among the purposes of the proposal, in addition to changing the name, are the elimination of the preferred stock with its large arrearages and the facilitation of the refinancing of its funded debt which it proposes to vigorously attempt promptly upon the completion of this plan.

Although assents from only two-thirds of the total stock are legally required, the directors state that they reserve the right to declare the merger effective only when assents are received in an amount sufficient in their opinion to warrant consummation of the plan. It is stated that in excess of 28% of the preferred and 51% of the common have already executed proxies indicating their approval.

Coast Housing Project Planned

LOS ANGELES—Confirmation has been obtained here of reports that the Metropolitan Life Insurance Company is to invest $12,500,000 in a multiple housing project in Hollywood. Work for about 3,000 men will start soon. The company has acquired 173 acres in Hollywood from the University of Southern California.

There will be two-story buildings of modern design, with about 2,700 rentable units to house between 10,000 to 11,000 persons.

Studies have been made by the architects, Leonard Schultze and Associates of New York, who will have local architects as associates.

320 Tons of A.C. for Chicago

CHICAGO—320 tons of air conditioning were installed in the city of Chicago during the month of December, 1940, according to the Commonwealth Edison Company. Installations included such applications as offices, residences, stores, theaters, and industrial plants.

Government Needs Draftsmen

WASHINGTON, D. C.—Engineering draftsmen in various optional fields are urgently needed by the United States Government. A civil service examination held last fall failed to produce enough eligibles to meet the demand of the national defense program. The United States Civil Service Commission has, therefore, reannounced the examination and will accept applications until December 31, 1941. The salaries of the positions range from $1,620 to $2,600 a year less a 3½ percent retirement deduction.

Optional branches in which applicants may qualify are: Architectural, civil, electrical, heating and ventilating, lithographic, mechanical, plumbing, radio, structural, topographic, and general—which includes any other branch except aeronautical, ordnance, or ship. High-school education except for substituted drafting experience is required. Applicants must also show paid drafting-room experience, or completion of a drafting course in a school specializing in drafting, or college engineering or architectural study; in addition they must show drafting experience in the optional branch chosen.

Competitors will not be required to take a written test, but will be rated on their education and experience.

Further information and application forms may be obtained from the Secretary of the Board of U. S. Civil Service Examiners at any first- or second-class post office, or from the U. S. Civil Service Commission, Washington, D. C.

Central Heat Preferred by Insurers

LOS ANGELES—A current development among Southern California insurance companies is for placing restrictions on the type of heating installation in plants engaged upon national defense contracts. With such factories considerably more liable to sabotage than the average non-defense plant, insurance companies are beginning to insist upon locating heating plants at points inaccessible to the workers in the production departments. Builders of new plants and remodelers of existing ones are being urged to install some type of remote heating system, preferably a plant located in a room separated from the main factory.

Factory owners are also being advised against the use of flame units installed directly in the areas to be heated. Open-flame wall heaters in the office sections of defense plants are also being frowned upon as an unnecessary menace. On the whole, the preference of insurance companies is for central heating systems as against individual flame wall and floor space heaters.

Library A.C. Ups Attendance

COALINGA, CALIF.—Attendance at the Coalinga District Library has jumped approximately 50% since the installation of air conditioning, according to Edward T. Murphy, vice-president in charge of marketing, Carrier Corporation.

The beautiful library, set in the midst of swaying palm trees in San Joaquin Valley, where mid-Summer temperatures often soar above the 100-degree mark, had been losing patronage rapidly and its 30,000 volumes were practically untouched on the shelves.

Librarian Howard M. Rowe, discovering that it was on scorching afternoons and sultry evenings that attendance showed the sharpest drop, decided to try air conditioning. A 10-ton air conditioning system serving the reading and studying rooms was installed.

Many persons who hadn't been near the library for years returned as regular patrons. School students once more used it as a reference library.

One of the contributing reasons for the pickup in attendance, was the reduction in street noises through the installation of inner doors for insulation purposes. Furthermore, employees themselves seemed more contented and there was less emotional friction due to the heat.

Preservation of rare books through elimination of the drying out encountered previously as a result of the hot, dry air of Coalinga, also has been reported by Librarian Rowe since air conditioning. Cracking of backs and binding because of dryness had been quite common. Another benefit has been a substantial reduction in the amount of cleaning.

The Coalinga District Library serves not only the city of Coalinga but an adjacent territory of 500 square miles.

70 Spaces Sold for Coast Show

SAN FRANCISCO—Plans for the Pacific Heating & Air Conditioning Exposition are progressing rapidly, according to a recent report from the exposition management. Scheduled for Exposition Auditorium, San Francisco, June 16-20, this will be the largest event of its kind ever held on the Coast. Up to January 1, 70 leading manufacturers had engaged more than 50% of the exhibit space in the main auditorium, and the remaining spaces are under active consideration.

The American Society of Heating & Ventilating Engineers, who are sponsoring the event, will hold its annual summer meeting during the same week. Also meeting at this time will be the Heating, Piping & Air Conditioning Contractors.

TEMPERATURES AND AMOUNTS OF HOT WATER FOR COMMON OPERATIONS

A—Unit Water Requirements for Common Operations (Gallons)

Personal Bathing and Toilet	
Tub Bath (adult)	15-20
Tub Bath (baby)	4
Shower	12
Needle Shower	30
Shaving	2
Personal Toilet	1

Home Laundry and Washing

Small washing machine holds from 12 to 15 gal. For average full family laundry, allow about 30 gal. of water or about 7½ gal. per person.

Public Laundry

No general rule, but one of long standing for estimating purposes is to allow one gallon per hour per piece of daily laundry capacity.

Dish Washing

In small residences, allow ¾ gal. per person per meal, or about 3 to 4 gal. per meal for average family.

In restaurants, allow from 1 gal. per person per meal in low cost restaurants to 2 gal. per person per meal in high cost restaurants, if hand dish washing is used; if machine dish washing, allow 1½ to 4 gal.

Cleaning and Scrubbing

For residences, allow arbitrarily 7 gal. per day, or about 2 gal. per 100 sq. ft. of floor per mopping. For offices and commercial buildings, allow about 4 gal. per 1000 sq. ft. of floor area per day.

Car Washing

Allow 50 gal. per car washed.

B—Water Temperatures (F) Suitable for Common Operations

Personal Uses	
Cleansing Bath (tub or shower)	95-100
Hot Bath	100-110
Tepid Bath	80-90
Baby Bath	90-95
Shaving	110-120
Personal Toilet	100-110
Hot Water Bottles	120
Shampooing	120
Hottest Water, commonly practical	140

Dish Washing	
Hand dish washing (governed by feeling of water on hands)	120
Hand rinsing	140
Machine washing—water can be any temperature under boiling if dishes are carefully scraped, say	160
If dishes not carefully prepared water should not exceed	140

Laundry and Washing

Ordinary washing can use water at up to 140F, occasional boiling of certain fabrics not harmful; others, notably fine fabrics and woolens, should not be exposed to more than lukewarm water, 100-120F.

Cleaning and Scrubbing

Hand scrubbing usually limited by feeling, and water cannot exceed 120F; machine scrubbing may use water up to 140F to advantage.
Car washing uses about 90F water.

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H. & V.'S REFERENCE DATA—191

TEMPERATURES AND AMOUNTS OF HOT WATER FOR COMMON OPERATIONS

Where hot water is required for common operations, the amount of hot water used is closely related to both the purposes for which it is wanted and the temperature of the water at which the operation can be carried out. Because of this close relation the Table on the other side of this sheet gives both the unit water demands and the water temperature considered suitable.

The importance of the relation between hot water demand and the water temperature can be made clear by taking, for example, the washing of an automobile. With a car of a given size and a given degree of dirtiness, let us say that 50 gallons of water at 90F must be used to wash the car. The question is how much of a demand on a hot water system is caused by such a requirement? Evidently, if the temperature of the hot water supply were 90F, then 50 gallons of such water would be required. Suppose, however, that hot water is available at a temperature of 130F and that cold water is to be had at 65F. The usual procedure would be to mix the hot and cold water to obtain a mixture at the desired temperature 90F. With the temperatures of 130F and 65F it would be found that the 50 gallons required to wash the automobile would be made up of 31 gallons of cold water and 19 gallons of hot water. Thus, the demand for hot water in this example is only about 38% of what it would be if the hot water were supplied at 90F.

As a second example consider processes involved in an ordinary tub bath. Here the amount of water required is fixed by the personal ideas of the user, but it has been found that the ordinary person draws about 15 gallons of water for the purpose. The temperature of the water used also depends on the ideas of the user, but the supposed limit of temperature is fixed by the reaction of the skin. Few people can tolerate a water temperature of more than 150F, and most people do not attempt so high a temperature, preferring one of, say, 100 to 115F.

As in the previous example, it will be noted that if the water is supplied at 110 to 115F the demand of hot water is 15 gallons. However, if the water supply is at a temperature of 140F then the usual practice would again be to mix the hot water and the cold water and thus attain a mixture of the desired temperature of 110 to 115F. With 70F cold water available it would be found that the 15 gallons would be made up of 8½ gallons of 140F water and 6½ gallons of 70F water. Here the demand for 140F water is only about 56% of what the demand would be if the water were supplied at 110F.

These two examples illustrate well the fact that hot water demands on any system are dependent on (a) the total quantity of water required for the process, (b) the temperature of the process, and (c) on the temperatures of the hot and cold water supplied.

In Part A of the Table on the other side of this sheet the quantities of water required for the common operations have been assembled from a variety of places. Since the amounts required do depend to a considerable extent on personal ideas, there is no means of definitely fixing these quantities. Those given in the Table may be said to report general averages and are the ones commonly given in published tables and handbooks. All of them are naturally subject to a considerable variation if applied in detail, but when used for general estimating purposes it is believed that they are sufficiently accurate.

In the same way the temperatures given in Part B of the Table on the other side of the sheet report the temperatures which can generally be expected. It is true that occasionally to meet specific requirements, such as sterilization, water temperatures higher than those shown in the Table are necessary and are used. The figures should be interpreted as indicative, showing closely enough for most estimating purposes, the temperatures at which water can be satisfactorily used for the operations listed. It is believed also that they are sufficiently accurate for the great majority of estimates.

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H. & V.'S REFERENCE DATA—192

PLAY SAFE...

with Beth-Cu-Loy Galvanized Steel Sheets

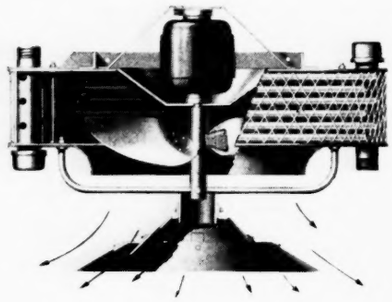
Factors of corrosion are at their very worst inside ducts and ventilators. Moisture-laden air continually bombards surfaces and seams. Where inside and outside temperatures differ appreciably, moisture condenses on the sheets. In industrial installations, dust particles and corrosive vapors add their destructive effects. All in all, ducts are exposed to hazards which call for some extra protection.

You can meet all threats to duct life simply and economically by using Beth-Cu-Loy Galvanized Steel Sheets. Doubly guarded against corrosion by a tight coating of zinc plus 0.20 to 0.30 per cent copper added to the steel itself, Beth-Cu-Loy Sheets far outlast ordinary sheets in actual service. Yet they cost only a few cents more per sheet. On your next installation, play safe with Beth-Cu-Loy.

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY

NEW EQUIPMENT



Sturtevant Downblast heater.

Sturtevant Unit Heater

NAME — Sturtevant Downblast speed heater.
PURPOSE — For supplying heated air directly downward.
FEATURES—It is said that since the heat is driven down at a higher velocity the Downblast heater is particularly suited for installation in buildings with high ceilings. Manufacturer states that the largest size heater will provide effective heating even when suspended 40 ft. above the floor level. When a low installation is desired deflection cones are used to give a wider diffusion of air stream. The unit heater consists of a circular extended surface heating element, protected by a screen guard, with copper tubes brazed into copper headers. Fins are of aluminum as are fan blades. Headers are on both sides of the coil to permit the rapid clearing of condensate. Connections are provided at both ends to allow the steam lines to be connected to whichever side is most convenient.
SIZES & CAPACITIES—Twelve sizes with capacities from 40,000 to 400,000 B.t.u. at 2 lb. steam pressure 60F entering air.
LITERATURE AVAILABLE—Catalog 454.
MADE BY—*B. F. Sturtevant Company, Hyde Park, Boston, Mass.*

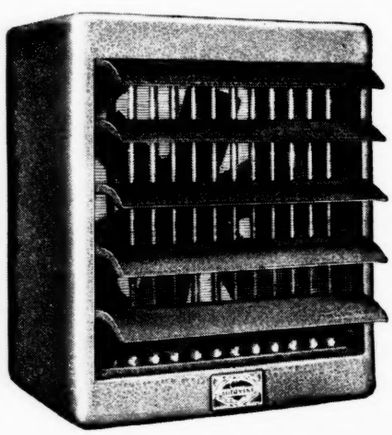
Westinghouse Reversed Refrigeration Air Conditioning Unit

NAME — Westinghouse plug-in Mobilaire WB-06R.
PURPOSE — This is a window type room air conditioning unit which both cools and heats.
FEATURES — The unit features the use of reversed cycle refrigeration for heating. A dial control is provided to vary the amount of outside air entering the room up to 60 c.f.m. The same dial is used to expel stale air, smoke, and odors. The unit can bring in or expel air whether the heat or cooling unit is in operation or not. The 1941 line of Mobilaires includes three other models which do not incorporate the heating features. No plumbing connections are necessary for installing any of the Mobilaires.
MADE BY — *Westinghouse Electric & Manufacturing Company, Mansfield, O.*

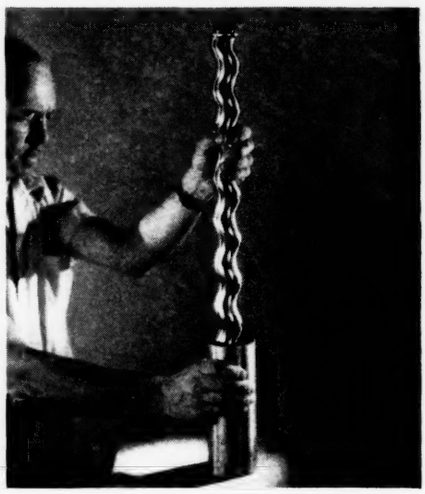
Year-round air conditioner which uses reversed cycle refrigeration for heating.

Autovent Unit Heater

NAME—Autovent steam unit heater.
PURPOSE — For heating air using steam.
FEATURES—This line of unit heaters has been completely re-designed and many new features are incorporated. Manufacturer states that the casing is entirely new and that streamlining and two-tone monel gray finish permits the use of the unit heater in almost any type of installation. The vanes or deflectors have been recessed for appearance and are said to be individually adjustable. The units employ the "31 series" Autovent non-overloading fan wheels and a special screw compression fitting is used between the tube and header to eliminate any welded or brazed joints. Coils are tested at 500 lb. static pressure and are designed to be used at any steam pressure from 2 to 150 lb. gauge.
MADE BY—*Autovent Fan & Blower Co., 1805 Kostur Ave., Chicago, Ill.*



Autovent steam unit heater.



Helical lifting element for Peerless pump.

Food Machinery Deep Well Pump

NAME—Peerless Hi-Lift Pump.
PURPOSE—For pumping water from deep wells.
FEATURES — This pump utilizes a simple helical rotor to lift water and is said not to have any impellers, plungers, pistons and valves. The helical element illustrated is the size used in a 4-inch diameter pump column which can be inserted in a drilled well to a depth of 100 ft. or greater. The element is connected to a shaft which extends to the surface of the ground and is operated by a direct connected motor on the top of a built-in pump head. The shaft is supported within the pump's casing by water-lubricated bearings. The stator in which the rotor element turns is locked to the bottom of the pump column inside of a metal sleeve. In case the pump is to be removed from the well for inspection or replacement it can be pulled out without lifting out the column or casing.
MADE BY—*Peerless Pump Division of the Food Machinery Corporation, 301 West Avenue 26, Los Angeles, Calif.*

Airox Deodorizers

NAME—Airkem deodorizers.
PURPOSE — For sterilizing air conditioning systems and for masking odors.
FEATURES—Manufacturer states that Airkem is a chemical product which will maintain a sterile condition in the air conditioning system and cancel all odors. It is also said to introduce into indoor atmosphere certain substances which are claimed to naturally contribute to the freshness of country air. The chemical is provided in canister form which is placed in the ducts close to the coils and filters. It is said that one canister is required for 1000 c.f.m.
MADE BY—*The Airox Co., 366 Madison Ave., New York, N. Y.*

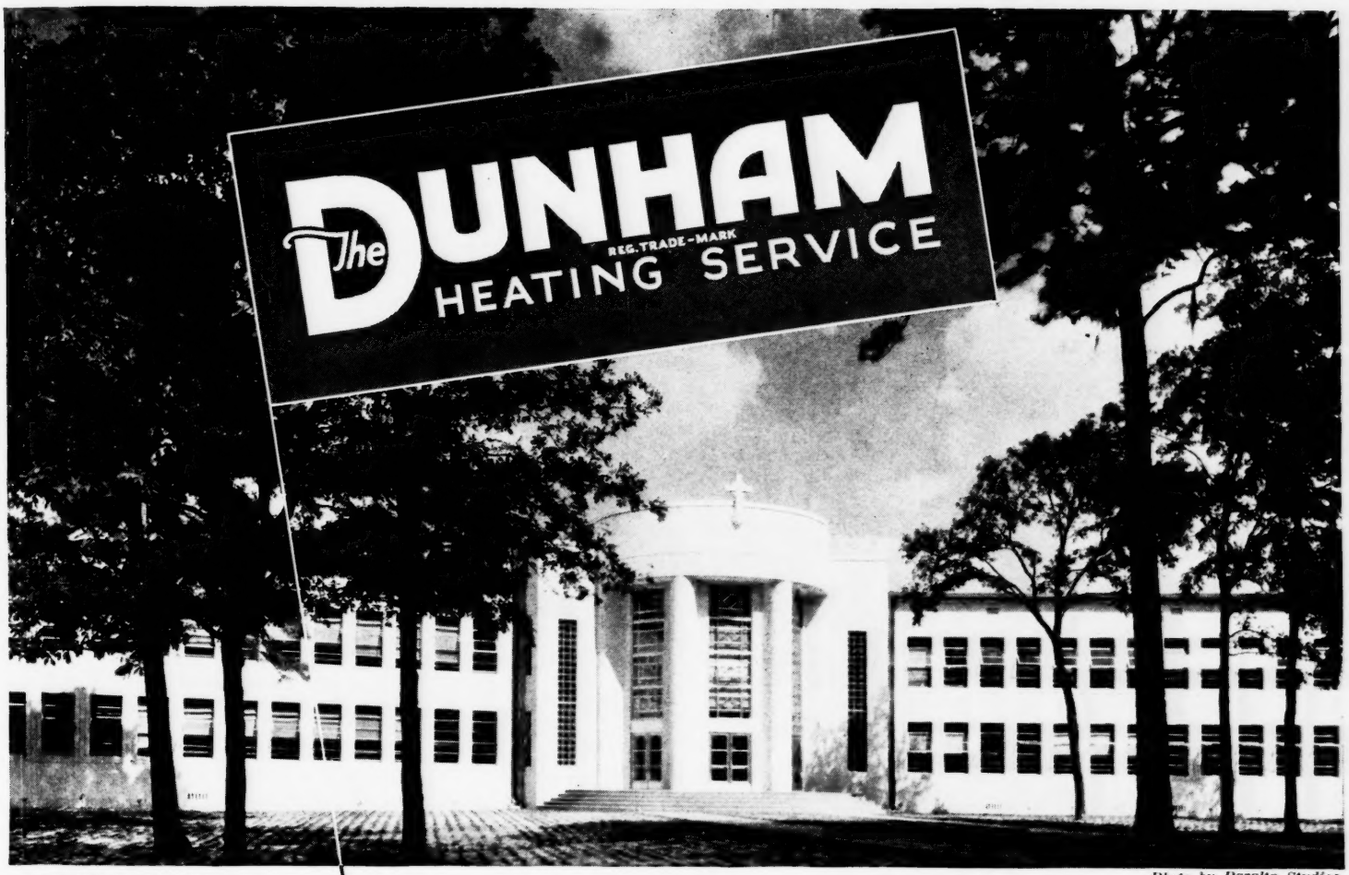


Photo by Paralta Studios

ST. THOMAS COLLEGE,
HOUSTON, TEXAS
Sub-atmospheric Steam Heating System

Architect: Maurice J. Sullivan
Heating Contractor: Callahan Co.

Undivided Responsibility stops "passing-the-buck"

To divide the responsibility for a satisfactory heating *system* by using units built by different manufacturers may lead to complications by "passing the buck" on installation details and slow up completion of the job.

"*Dunham Heating Service*"

- Eliminates "buck-passing" by decreasing the number of suppliers.
- Works with contractors to provide quick and efficient installation
- Works with operating men to see that good economical heating is secured
- Unifies the work of many to provide heating as specified

"Dunham Heating Service" is available through the telephone in more than 60 cities, or by correspondence to C. A. Dunham Company, 450 East Ohio Street, Chicago

DUNHAM *has made* HEATING SERVE YOU BETTER *since* 1903

PERSONALS & PERSONNEL

Airtemp Division of Chrysler Corporation has been elected to membership in the Air Conditioning and Refrigerating Machinery Association, Inc., according to *William B. Henderson*, ACRMA executive vice-president.

Anemostat Corporation of America, New York, held its annual sales conference December 9-10 with all sales representatives east of the Mississippi present. The company has announced the appointment of The Leffel Co. to succeed the Disney-Leffel Co. as Kansas City representatives. Other appointments recently made by the company include The Sioux Steel Co., Sioux Falls, S. D., and the Sullivan Valve Engineering Co., Butte, Mont., to represent Anemostat in South Dakota and Montana, respectively. W. W. Neale of Richmond, Va., has been appointed field representative for Anemostat in central and western Virginia. Lawrence Trant & Co., Norfolk, Va., will handle sales and engineering in the Norfolk district. Field representatives in the New England territory recently appointed include Robert A. Mace, Woodmont, Conn., to handle that state, and George C. Warren Co., Portland, Me.

Blackmer Pump Co., Grand Rapids, Mich., has effected a reorganization of its sales divisional set up. *Bruce P. Hetler*, formerly general sales manager, has been made manager in charge of engineering sales, and *J. B. Trotman* now becomes general sales manager in charge of sales distribution and advertising. Mr. Trotman, a newcomer to the Blackmer organization, has had years of pump sales experience with Goulds Pumps, Inc., and lately as manager for the Roots-Connersville-Blower Corporation, turbine pump division.

Blackmer Pump Co., Grand Rapids, Mich., has let contracts for an addition to its plant and office building, as part of a general program of expansion of manufacturing facilities to accommodate increased business. The new addition will double the space of the engineering department, increase the office facilities and add somewhat to the testing and production departments.

Blaw-Knox Company, Pittsburgh, has appointed *S. J. Horrell* vice-president of the Power Piping Division. *Harry Gray* has been engaged by the company and appointed chief engineer of the Division.

The Bryant Heater Co., Cleveland, has appointed *C. F. Cushing* as sales promotion manager, *D. E. Leslie* as advertising manager, and *H. W. Heisterkamp* as manager of the air conditioning sales department. Mr. Cushing joined the Bryant engineering department in 1935 to assist in the development of silica gel dehumidifiers. In 1938, he became manager of air conditioning sales. Mr. Leslie has been a member of the Bryant staff since 1935, prior to which he was house heating salesman with Minneapolis Gas Light Company. Mr. Heisterkamp joined Bryant's engineering department in 1933 in the development of heating equipment and dehumidifiers. He will assume the responsibility of tripling dehumidifier sales for 1941.

The Burt Manufacturing Company, Akron, Ohio, has awarded contracts for the design and construction of a $50,000 addition to its existing facilities at South High and South Streets, Akron, to The Austin Company. The addition is needed to handle an increased demand for ventilators produced by the company for use in industrial plants. About 18,000 square feet of floor space will be provided in the building.

Chelsea Fan & Blower Co., Inc., N. Y., has purchased its own plant at Olsen & Grove St., Irvington, N. J. Arrangements have been made for a no-toll charge phone service for metropolitan New York accounts under the number of Enterprise 6094.

Chrysler Corp., Airtemp Division, Detroit, has appointed *Earl Marr* general sales manager. The appointment comes within a year from Mr. Marr's last appointment as sales manager of the heating division of Airtemp, a position he took over in November, 1939. In his new capacity Mr. Marr will be responsible for the sales management of both the heating and cooling equipment.

Conco Corp., Mendota, Ill., is building a 22,500 sq. ft. annex to its plant for warehousing to release some of the present space for additional manufacturing.

Deane E. Perham, Chicago, formerly with the refrigeration division of the Chicago Master Steamfitters Association, has joined the *Vilter Manufacturing Co.* of Milwaukee with offices at 230 W. Superior St. in Chicago.

Fred L. Witsell, superintendent of the heating division, Toledo Edison Co., Toledo, Ohio, has been made general manager of the *Pueblo Gas & Fuel Co.*, Pueblo, Ind. He has been succeeded by *Gus Weiders* in Toledo.

General Electric Company of Schenectady, N. Y., has announced the movement of its personnel and equipment of the Chicago district, together with its personnel and equipment of its affiliated companies to the new G.E. $1,500,000 building. The building is 7 stories high and occupies an entire city block. It is equipped with the latest light and air conditioning and was designed by the architects *Holabird & Root*, and erected by the *James Stewart Corp.*, general contractors. Housed in the new building will be General Electric's sales engineering and servicing operations in eleven middle western states and parts of three others, as well as *Carboloy Co., Inc.; R. Cooper, Jr., Inc.; General Electric Contracts Corp.; General Electric Supply Corp.;* and *Locke Insulator Co.*

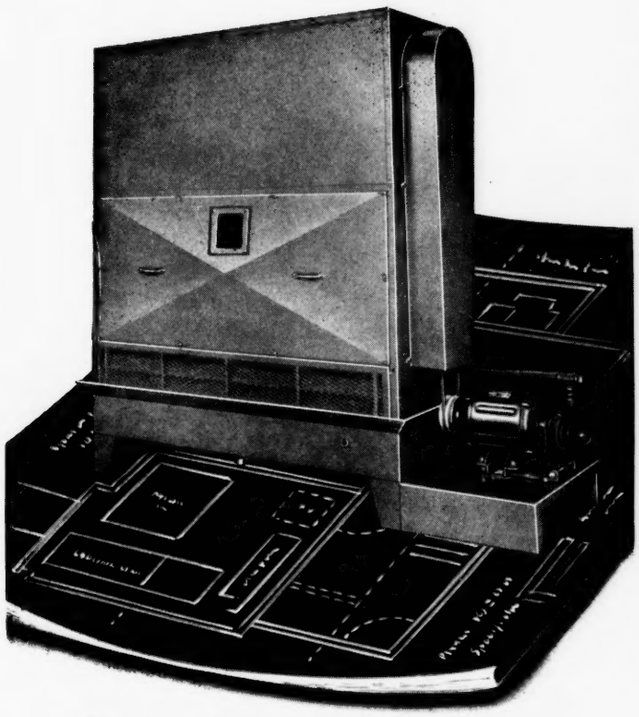
General Electric Co., Air Conditioning Div., Bloomfield, N. J., will be managed by *John P. Rainbault*, according to *H. L. Andrews*, vice-president. Formerly manager of the company's electric clock section in Bridgeport, Conn., Mr. Rainbault succeeds *Stuart M. Crocker*, who was recently named a vice-president concerned with customer relations.

Industrial Unit Heater Association, 208 General Motors Building, Detroit, Mich., announces that at the annual meeting in Cleveland, *A. B. Donkersley* was elected president, *C. C. Cheyney*, vice-president, and *L. O. Monroe*, secretary-treasurer, for the ensuing year. The next regular meeting is to be held in Detroit on April 17, 1941.

Jas. P. Marsh Corporation, Chicago, has appointed *James Emmett, Jr.*, assistant sales manager; *O. William Hage*, manager of the gauge division, and *E. C. Kluger*, manager of the heating division.

McQuay, Inc., Minneapolis, Minn., have announced the appointment of *Edward M. Fox* as advertising and publicity manager. Mr. Fox, before coming to McQuay, was associated with the advertising department of the Minneapolis Journal for ten years, the Milwaukee Sentinel, and more recently with the L. E. Waterman Company of Newark, N. J.

(Continued on page 64)



For Performance and Economy

MARLO INDUSTRIAL COOLERS

Available in a complete range of sizes—15 models.

One single motor drives pump and fan. Bearings are self-aligning, mechanically sealed. Corrosion-safe wheels and scrolls.

SPRAY and DRY COIL types finned and bare pipe surface.

Our new bulletin 403 illustrating the proper method of selection for controlled humidities and temperatures is yours on request.

MARLO COIL COMPANY
6135 Manchester Ave., St. Louis, Mo.
Refrigerating Equipment Manufacturers

TR-AP-IT

Keeps Any Refrigeration System CLEAN

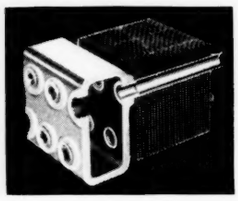
AP

DEPENDABLE

Progressive Service Engineers Use and Recommend — and Aggressive Jobbers Stock and Talk AP Products.

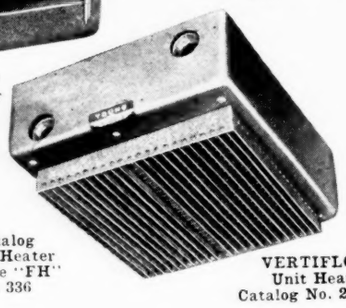
AUTOMATIC PRODUCTS COMPANY
2462 NORTH THIRTY-SECOND STREET
MILWAUKEE WISCONSIN

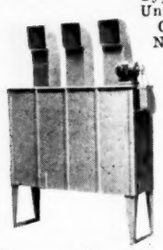
SPECIFY YOUNG FOR High Efficiency HEATING



Copper alloy tubes are rolled (not brazed) into sturdy, cast alloyed iron headers—then reinforced with snug-fitting ferrules for greater strength, longer life.

Type "SH" Unit Heater Catalog No. 2738





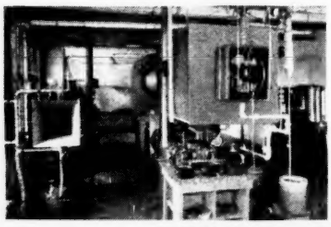
Catalog Unit Heater Type "FH" No. 336

VERTIFLOW Unit Heater Catalog No. 2540

Young heating units have a record of high efficiency and economy in all types of installations. That's because every step in their production—design, selection of materials, fabrication and final testing—must meet rigid standards to insure the highest degree of heating efficiency. Painstaking research in the laboratory and in the field assures you that their performance will meet the most exacting requirements of modern heating plants. Available in a wide selection of sizes and capacities. For complete details write:

YOUNG RADIATOR CO., Dept. 101B, Racine, Wisconsin

Offices In All Principal Cities.



CERTIFIED CAPACITY

All Young units are tested and rated for heat output and air delivery in accordance with Standard test codes of the American Society of Heating and Ventilating Engineers.

Young High Efficiency

HEATING COOLING AND AIR CONDITIONING UNITS

UNIT HEATERS • CONVECTORS • CONDENSERS • EVAPORATORS • AIR CONDITIONING UNITS • HEATING COILS • COOLING COILS

Young Quality

OIL COOLERS • GAS, GASOLINE, DIESEL ENGINE COOLING RADIATORS • INTERCOOLERS • HEAT EXCHANGERS • ENGINE JACKET WATER COOLERS

REG. U.S. PAT. OFF.

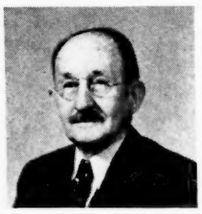
(Continued from page 62)

National Warm Air Heating and Air Conditioning Association announces that their new address is 145 Public Square, Cleveland, Ohio.

S. J. McCarthy

Norge Heating and Air Conditioning Division of Borg-Warner Corp., Detroit, Mich., has announced the re-alignment of executive personnel. Heading their list of appointments were those of *S. J. McCarthy*, sales manager, and *C. S. Davis, Jr.*, secretary-treasurer. Other appointments are: *George Neumann*, in charge of engineering; *G. M. Johnston*, in charge of service and sales engineering; *E. R. Nichols*, central divisional sales representative with headquarters in Detroit; *H. W. Winningham*, Western divisional sales representative with headquarters at Seattle, Wash.; *I. J. Amish*, Northeastern divisional sales representative with headquarters at Rochester, N. Y., and *H. C. Altenberg*, Mideastern divisional sales representative with headquarters at Upper Darby, Penna. The new plan of organization is understood to be a basic step in a long-range program to expand and diversify the manufacturing and distributing activities of the company. The addition of new products to the Norge Heating & Conditioning line will be the next step and announcement of some of these is anticipated within sixty days.

Spencer Heater Division, Aviation Manufacturing Corp., Williamsport, Pa., has appointed *H. F. Becker* as sales representative for the Long Island territory. He will operate out of the New York office in the Architects Building, 101 Park Ave., N. Y. *Leonard A. Hoxeley* has been appointed special sales representative for the Scranton, Pa., territory. He will operate out of the Scranton office of the Rafter Building, at Washington and Linden Street.



H. N. Middleton

B. F. Sturtevant Company, of Hyde Park, Boston, Mass., announces that *H. N. Middleton* has been appointed engineering consultant on dust and fume control and pneumatic conveying problems for the eastern division of this country. Mr. Middleton was formerly connected with the Camden, N. J., branch and has been associated with the B. F. Sturtevant Company for many years. His experience for over 50 years dates back to the pioneering period of the dust and fume control and pneumatic conveying industries and today he is one of the best informed and most experienced men in these highly specialized fields.

York Ice Machinery Corp., York, Pa., announces that at the annual meeting of the stockholders held on Jan. 14, 1941, the following directors were reelected: *G. E. Fee, C. W. Fenninger, J. W. Gitt, P. H. Glatfelter, V. K. Keesey, E. A. Kleinschmidt, S. E. Lauer, S. H. Shipley, S. J. Shipley, W. S. Shipley, and L. Williams.* At the conclusion of the stockholders' meeting the directors met and elected the following officers to serve the ensuing year: *W. S. Shipley*, chairman of the board; *S. E. Lauer*, president; *E. A. Kleinschmidt*, executive vice-president; *S. J. Shipley*, vice-president and treasurer; *L. Williams*, vice-president, and *V. K. Keesey*, secretary. *J. F. Lebor* was appointed assistant treasurer and *D. M. Magor*, comptroller.

NEW TRADE LITERATURE

Air Conditioning. A standard size 16-page bulletin C-1150-B6 entitled, "Modern Air Conditioning for Stores." Gives a considerable amount of information and a large number of photographs which show typical installations of Worthington-Carbondale air conditioning in stores. Also gives some information on the Worthington-Carbondale line of air conditioning equipment. WORTHINGTON PUMP AND MACHINERY CORPORATION, Harrison, N. J.

Air Meter. A single page, standard size catalog, D.R. 5-20, on which is illustrated the Detroit Grillometer which is a direct reading air flow meter. Instrument is designed to measure air velocities at outlet or inlet grille from 0 to 2000 f.p.m. Catalog also gives information on the Detroit air meter draft gauge. THE DETROIT AIR CONDITIONING SERVICE CO., INC., 1474 Holden at Trumbull, Detroit, Mich.

Controllers. An 84-page, standard size controller catalog which gives information on the complete line of American self-operated controllers including combined temperature controller with indicators, pressure controllers, wide range indicating controllers, wide range non-indicating controllers and controlo graphs. In addition, catalog covers the complete line of diaphragm motor valves, giving diaphragm motor valve capacity charts. Also contains a large amount of other information. AMERICAN SCHAEFER & BUDENBERG INSTRUMENT DIVISION, MANNING, MAXWELL & MOORE, INC., Bridgeport, Conn.

Filters. An illustrated price list on Research Air filters. Explains various types and sizes of filters, details and specific uses, and gives information on the construction and efficiency features. RESEARCH PRODUCTS CORPORATION, Madison, Wis.

Motors. A 4-page standard size bulletin BCA-120 which illustrates and describes the Century Capacitor single phase motor which is available in sizes up to 20 hp. CENTURY ELECTRIC COMPANY, 1806 Pine St., St. Louis, Mo.

Refrigeration. A standard size 44-page catalog AC-139 entitled, "20 Years Centrifugal Refrigeration." Included is a description of the history of the Carrier's centrifugal machine which was developed by Dr. Carrier starting in 1918. All the parts of the machine are shown by simple perspective drawings which are accompanied by direct non-technical descriptions of the parts and the functions they perform. The refrigerating cycle is shown in a four-color diagrammatic drawing. A chapter on performance compares the cycle efficiencies of refrigerants as well as the mechanical efficiencies of refrigerating systems. Also included are many illustrations and descriptions to show the application range of Carrier's centrifugal machines. CARRIER CORPORATION, Syracuse, N. Y.

Refrigeration. Standard size, 6-page folder on Worthington centrifugal refrigeration for air conditioning and industrial applications. Gives information on capacities, performances, refrigerants, applications, specifications and dimensions. CARBONDALE DIVISION, WORTHINGTON PUMP AND MACHINERY CORP., Harrison, N. J.

Registers. A standard size, 28-page catalog, No. 41G on the Independent line of registers and grilles. Gives information on construction, dimensions, list prices, and styles of all Independent registers, cold air faces, venti-

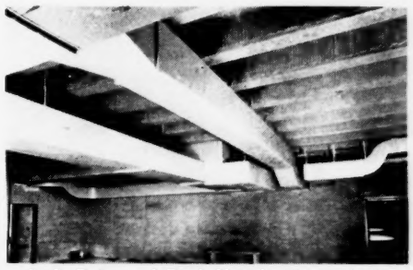
(Continued on page 66)

In RADIO STATIONS
CHURCHES
HOSPITALS—
WHEREVER

Quiet
IS ESSENTIAL—
USE *Careyduct*
THE ALL-ASBESTOS INSULATED DUCT
FOR AIR CONDITIONING SYSTEMS

CAREYDUCT combines both duct and insulation. Made entirely of asbestos, it hushes fan and other equipment noises; cuts down outside noise; eliminates metallic "cracking" due to change in air pressure or expansion strain. Especially desirable for use in air conditioning of churches, hospitals, radio studios—wherever noise is objectionable.

Research Building, Children's Hospital, Cincinnati



S. S. Peter and Paul Church, Norwood, O.

Control Room, Radio Station WCKY, Cincinnati

CAREYDUCT is fireproof, rust-proof, permanent. Simple slip-joint construction and standardized parts make fitting on job easy. Surprisingly economical. Write for interesting CAREYDUCT Manual—Address Dept. 49.

THE PHILIP CAREY COMPANY • Lockland, Cincinnati, Ohio
Dependable Products Since 1873
IN CANADA: THE PHILIP CAREY COMPANY, LTD. Office and Factory: LENNOXVILLE, P. Q.

(Continued from page 65)

lators and grilles. THE INDEPENDENT REGISTER CO., 3747 East 93rd Street, Cleveland, Ohio.

Unit Heaters. Two standard size catalogs on Modine unit heaters. The first is a 32-page illustrated catalog No. 140-E on Modine horizontal delivery heaters. Includes complete engineering data and information on location and installation of unit heaters. Use of unit heaters for drying and processing applications is described and illustrated and there is also included description and data on unit heaters used in textile mills and other applications where lint and foreign matter in the air prevents the use of conventional unit heaters. The second catalog has 16 pages, is designated as catalog 140-C, and describes and illustrates the Modine line of vertical delivery unit heaters. It contains complete engineering data. MODINE MANUFACTURING COMPANY, Racine, Wis.

Water Conditioning. A standard size, 9-page folder giving information on the water conditioning equipment for boilers. Folder is entitled, "Standard Methods—No. 122." PROPORTIONEERS, INC., Providence, R. I.

H&V'S PHOTOS

Cover—U. S. Navy photo.
Page 11—U. S. Navy photo.
Pages 18 and 21—Ford Motor Company, Dearborn, Mich.
Pages 22 and 23—The Austin Company, Cleveland, Ohio.
Page 24—Buffalo Forge Co., Buffalo, N. Y.
Pages 36, 37, 38 and 39—General Electric Co., Bloomfield, N. J.
Page 45—Hedrich-Blessing Studio, Chicago, Ill.

COMING EVENTS

FEBRUARY 25-27. Ohio Sheet Metal Contractors Association convention to be held in Columbus, Ohio. Headquarters, Deshler-Wallick Hotel. For further information, write to A. E. Bogen, Convention Committee Chairman, Deshler-Wallick Hotel, Columbus, Ohio.

MARCH 17-22, 1941. National Oil Burner Progress Exhibition of oil heating and air conditioning equipment. Commercial Museum, Philadelphia. Convention headquarters, Benjamin Franklin Hotel. Further information available through C. F. Curtin, Oil Burner Institute, 30 Rockefeller Plaza, New York.

JUNE 10-13, 1941. The 32nd Annual Meeting of the National District Heating Association. To be held at the William Penn Hotel, Pittsburgh, Pa.

JUNE 16-20, 1941. The Pacific Heating and Air Conditioning Exposition, Exposition Auditorium, San Francisco, Cal. Managed by the International Exposition Company, Grand Central Palace, New York.

JUNE 16-20, 1941. Meeting of the Heating, Piping and Air Conditioning National Association. To be held at St. Francis Hotel, San Francisco, Cal.

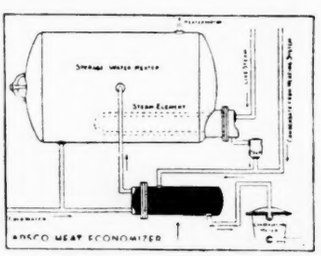
JUNE 16-20, 1941. Summer Meeting of the American Society of Heating and Ventilating Engineers. To be held at Palace Hotel, San Francisco, Cal.

JUNE 23-27, 1941. Annual meeting and exhibit of the American Society for Testing Materials. Palmer House, Chicago, Ill. For information, write Society at 260 So. Broad St., Philadelphia, Pa.

OCTOBER 14-17. 70th annual meeting of the American Public Health Association to be held at Convention Hall, Atlantic City, N. J. Headquarters, Hotel Traymore. For information, write to American Public Health Association, 1790 Broadway, New York, N. Y.

ADSCO HEAT ECONOMIZERS
FOR RECLAIMING HEAT FROM HOT CONDENSATE

ADSCO Instantaneous Type Heat Economizer illustrated above may be used to preheat domestic water supply before passing it to a storage water heater as indicated below.

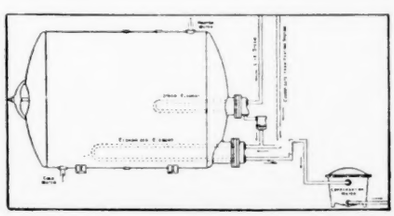


Submit details of your Water Heating or Cooling Problem to ADSCO Engineers for Recommendations

Put your hot condensate to work with an ADSCO Heat Economizer to preheat cold water for domestic hot water, cleaning or processing purposes. Economical in cost. Pays for itself in fuel saved. Easy to install. Built for years of service.

Every industrial plant, college, institution, hotel, hospital, and public utility has one or more possible applications for an ADSCO Heat Economizer. Write for Bulletin No. 35-76V.

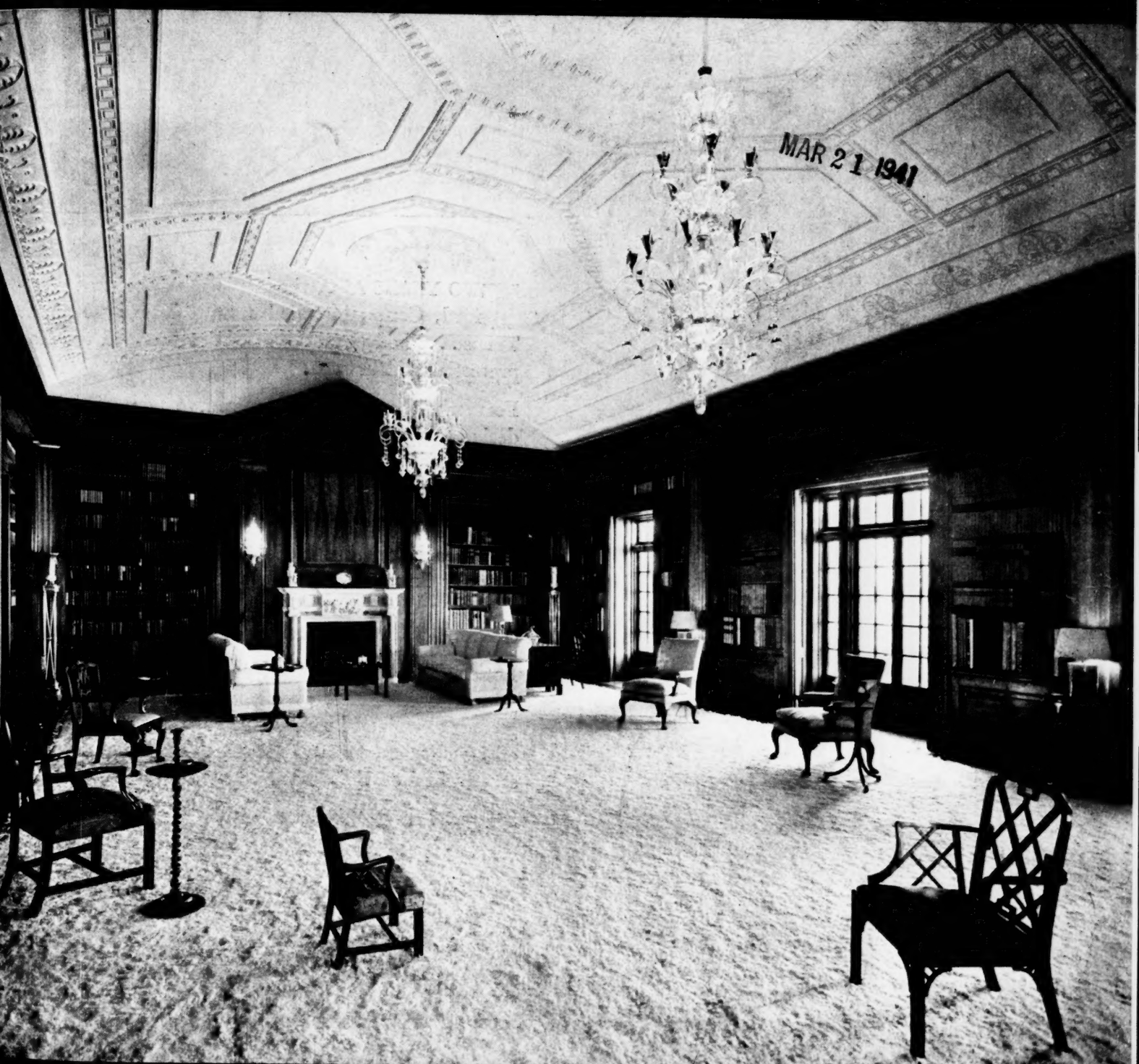
ADSCO Storage Type Water Heater illustrated above may be utilized as an economizer with or without an auxiliary heating element as indicated in the sketch below.



AMERICAN DISTRICT STEAM COMPANY
NORTH TONAWANDA, N.Y.
IN BUSINESS OVER SIXTY YEARS

HEATING AND VENTILATING

The Air Conditioning Monthly



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